

**ANNUAL REVIEW OF BPA-FUNDED PROJECTS IN  
NATURAL AND ARTIFICIAL PROPAGATION  
OF SALMONIDS**

**March 27-29, 1985  
Holiday Inn Airport  
Portland, Oregon 97220**

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## INTRODUCTION

The Fish and Wildlife Division of Bonneville Power Administration (BPA) hosted a meeting for contractors to present the results of fiscal year 1984 research conducted to implement the Northwest Power Planning Council's Fish and Wildlife Program.<sup>(a)</sup> The meeting focused on those projects specifically related to natural and artificial propagation of salmonids.

The presentations were held at the Holiday Inn Airport in Portland, Oregon, on March 27-29, 1985. This document contains abstracts of the presentations from that meeting. Section I contains abstracts on artificial propagation, fish health, and downstream migration, and Section II contains abstracts on natural propagation and habitat improvement.

The abstracts are indexed by BPA Project Number and by Fish and Wildlife Program Measure. The registered attendees at the meeting are listed alphabetically in Appendix A and by affiliation in Appendix B.

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<sup>(a)</sup> Northwest Power Planning Council, Fish and Wildlife Program, Amended October 10, 1984.

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**SESSION I**

**ARTIFICIAL PROPAGATION, FISH HEALTH, AND  
DOWNSTREAM MIGRATION**

**AN EVALUATION OF THE CONTRIBUTION OF CHINOOK SALMON  
REARED AT COLUMBIA RIVER HATCHERIES TO THE  
PACIFIC SALMON FISHERIES**

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Program Measure Number: 704 (h)**

**Relationship to Program Measure :** This project does not directly address a Fish and Wildlife program measure but does provide information relevant to Program Measures 504 and 704. The results from this project will provide a basis for improved propagation of fall chinook at existing facilities [704 (h) ], provide data to determine the effectiveness of hatcheries constructed as mitigation for hydroelectric developments, and provide guidelines for assessing the contribution of hatcheries and low-capital propagation facilities constructed under the Program [704 (i) , (j) ]. In addition, data from this project are important to state harvest management agencies and regulatory bodies, such as the Pacific Fishery Management Council, which establish escapement objectives [ 504 (a) ], regulate harvest [504 (b) ], and examine mixed stock fisheries [504 (c) ].

**This project is a cooperative effort among the Washington Department of Fisheries (WDF) , Oregon Department of Fish and Wildlife (ODFW) , U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS) and Bonneville Power Administration (BPA). The fishery agencies jointly developed the project objectives and study design.**

**Technical Results :** Fall chinook from brood years 1978 through 1981 were tagged at 18 to 20 facilities on the Columbia River System. Nearly 14 million tagged and 335 million untagged fall chinook were released from 1979 to 1982. Catches of these fish began occurring in 1980 and will continue through 1986. Final catch data are available through 1982 for most of the major fisheries on the Pacific coast. Three years of final catch data are available for analysis of the 1978 brood and 2 years of data are available for the 1979 brood.

**It is evident that the contribution of the 1979-brood fish to the Pacific coast fisheries will be larger than that for the 1978-brood. Contributions per 1000 fish released for all hatcheries combined are 2.7 for the 1978 brood and 3.1 for the 1979 brood. Fishery contributions among hatcheries within the same brood year vary substantially. Spring Creek Hatchery has the greatest contribution to the fisheries at 8.4 and 12.2 fish per 1000 fish released for the 1978 and 1979 broods, respectively. The Spring Creek contribution is followed by Stayton Pond, Abernathy, Bonneville, and Big Creek at 6.4, 4.6, 2.8, and 2.6 fish per 1000 released for the 1978 brood. Contributions for the 1979 brood are 7.4, 6.2, and 4.5 for Big Creek,**

**Stayton Pond and Abernathy, respectively. Other facilities had contributions of 2 fish or less per 1000 releases. These contributions are minimums since final data for all possible catch years and fisheries are not yet available.**

**Technical Review :** The study design and results are technically reviewed by staff from WDF, ODFW, USFWS, and NMFS.

**Evaluation of Effectiveness:** Data from this study are already stimulating research projects to improve the progration of fall chinook at WDF facilities.

**Degree of Program Measure Fulfillment:** When completed, this non-measure project will have determined the distribution, contribution, and value of the fall chinook production from each rearing facility on the Columbia River to the Pacific coast salmon fisheries. It will also have determined the contribution of hatchery fall chinook from the Columbia River to individual Pacific salmon fisheries by age class of fish.

#### **EVALUATION OF A SUBUNIT VACCINE TO INFECTIOUS HEMATOPOIETIC NECROSIS (IHN) VIRUS**

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BPA Project Number: 84-43  
Program Measure Number: 704 (h)**

**Relationship to Program Measure :** The goal of this project under Program Measure 704 (h) (4) is to develop and test an effective, safe, and economical vaccine for infectious hematopoietic necrosis virus (IHNV), a major pathogen in Columbia River steelhead and salmon fish stocks. The incidence of IHNV infections in hatcheries along the Columbia River has risen at an alarming rate. More than 25 million eggs and fish have been destroyed in the past four years in an attempt to control the disease. The potential value of this resource has been estimated at over \$230 million.

**Technical Results:** A prototype subunit vaccine to IHNV is being developed by recombinant DNA techniques. The techniques involve the isolation and characterization of the glycoprotein gene, which encodes the viral protein responsible for inducing a protective immune response in fish. The viral glycoprotein gene has been cloned and a restriction map of the cloned gene has been prepared.

**Preliminary DNA sequence analysis of the cloned gene has been initiated so that manipulation of the gene for maximum expression in appropriate**

plasmid vectors is possible. A recombinant plasmid containing the viral gene inserted in the proper orientation adjacent to a very strong lambda promoter and ribosome binding site has been constructed, and studies are now being conducted to assess viral gene expression. Immunization trials with purified viral glycoprotein indicate that fish are protected against lethal doses of IHNV. In addition, cross protection immunization trials with different strains of IHNV have been initiated.

**Technical Review:** The methods used to obtain the viral gene have been published (Virology 53: 462-468). The dideoxy chain termination method for DNA sequence analysis and the recloning of the isolated gene in single-stranded M13 phage vectors have been conducted as described in Gel Electrophoresis of Nucleic Acids, A Practical Approach (ed. Rickwood and Hames, 1982, IRL Press Limited, Oxford). Immunization trials have been conducted as described in J. Fish Disease 5:197-205).

**Evaluation of Effectiveness:** The development of a viral vaccine by molecular cloning is attractive because the result is an inexpensive, subunit-type vaccine that has none of the drawbacks of live viral vaccines. The problems of recombination and reversion to virulence are eliminated. Moreover, once efficient expression of the virus protein has been attained in bacteria, vaccine production should be very inexpensive. The ultimate evaluation of effectiveness will come from field trials and the adoption of the vaccine by hatchery managers for treatment of the fish.

**Degree of Program Measure Fulfillment:** Once the vaccine has been demonstrated to be fully effective in laboratory trials and all parameters governing the immunization process (e.g. , dose, age of host, duration of immunity) have been characterized, then field trials should be initiated.

#### **EFFECTS OF VITAMIN NUTRITION ON THE IMMUNE RESPONSE OF HATCHERY-REARED SALMONIDS**

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Program Measure Number: 704 (h)(4)**

**Relationship to Program Measure:** This project, which addresses Program Measure 704 (h) (4)) will determine ways to improve fish feeds so that salmon smolts will be healthier, more resistant to diseases, and better able

to survive to adulthood after release from hatcheries. The results also will be applicable to hatcheries that operate under Program Measures 704 (i, j, and k).

**Technical Results :** Five of the immunoassays to be used in assessing immunocompetency in the salmon have been standardized. These assays are as follows:

**I. In vitro stimulation of Plaque-forming Cells (Antibody Producing Cells) --** The antigen used in these preliminary studies was trinitrophenylated lipopolysaccharide (TNP-LPS) . TNP-LPS is a chemically defined, standard antigen used in many animal systems. These antibody producing cells have also been detected in response to Vibrio anguillarum antigen. Thus, the antibody responses may be assessed, without the need to challenge animals and hold them in special holding tanks.

**II. Mitogen Responses --** The mitogenic responses to lipopolysaccharide (E. coli) , phytohemagglutinin, concanavalin A, pokeweed mitogen, and V. anguillarum extract have all been optimized for splenic and anterior kidney lymphocytes.

**III. Mixed Lymphocyte Responses --** The mixed lymphocyte reaction has been observed to occur with combinations of anterior kidney lymphocytes from different spring chinook. Mixing of these lymphocytes can result in stimulation indices of up to eight times the normal background.

**IV. Antibody Response --** The first stages of a sensitive enzyme linked immunosorbent assay (ELISA) system for the detection of anti-KDB antibodies in salmon has been developed. R. salmoninarum antigens have been isolated and successfully used in our ELISA system.

**Technical Review :** Not applicable.

**Evaluation of Effectiveness :** The project is designed to provide results which are directly applicable to formulating practical production diets. Effectiveness will depend upon the extent to which nutritionists and feed manufacturers heed and apply recommendations for producing improved economic feeds.

**Degree of Program Measure Fulfillment:** The work addresses only one aspect of disease control, i.e. , improved nutrition. It is limited to only a few vitamins and one species of fish. The nutritional needs of other species will need to be investigated. Also, several vitamins remain to be examined, and the effects of other classes of nutrients and nutrient interactions need further study.

**BIOENERGETICS OF JUVENILE SALMON DURING THE  
SPRING OUTMIGRATION**

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Program Measure Number: 404 (c)(2)**

**Relationship to Program Measure:** Program Measure 404 (c) (2) directs BPA to fund studies to determine the causes of juvenile salmon mortality in mainstem reservoirs, to determine the potential for rearing anadromous fish, and to determine methods of improving the survival of hatchery-produced fish in these reservoirs. This study examines the hypothesis that changes in the Columbia basin have increased energy demands during the seaward migration of juvenile spring chinook salmon (Onchorhynchus tshawytscha) and resulted in decreased survival. Since water temperature, flow, and migration rate information are used as inputs to a model, the study was dependent on the same information used to establish and operate the Water Budget under Program Measure 304.

**Technical Results :** A model was developed to simulate the energy budgets of juvenile chinook salmon as a function of migration rate, water temperature, flow regime, and food intake.

Laboratory and field observations were completed to develop input parameters for the model and to provide empirical data with which to compare model simulations. Results indicated that the seaward migration of spring chinook salmon had two distinct phases. During the first phase, smolts underwent a post-release surge in Na<sup>+</sup>-K<sup>+</sup> ATPase activity, a 55% decline in lipid content, and increased respiration rates as measured by oxygen consumption. During the second phase, the migration was completed by smolts with low lipid contents and high metabolic rates. Model simulations of mean smolt weight during seaward migrations indicated that model output was most sensitive to food consumption and respiration rate parameters. Preliminary simulations use input data from three years (1974, 1977, and 1978) that represent the 50-year high, low, and medium Columbia basin flows. Several migration patterns were simulated using the observed 50-year range of flows to develop possible recommendations for improved salmonid survival.

**Technical Review :** The original proposal and study design were reviewed by fishery agencies of the Fish and Wildlife Council and BPA. Annual reviews and site visits by BPA have also been conducted.

**Evaluation of Effectiveness :** We have been unable to compare the simulations with empirical data under low flow conditions since flows have been high during years the project was conducted.

**Degree of Program Measure Fulfillment:** This project addresses only salmon mortality in mainstem reservoirs. *Mortality* topics that require further investigation will be identified at the conclusion of the project.

**EPIDEMIOLOGY AND CONTROL OF INFECTIOUS DISEASES OF  
SALMONIDS IN THE COLUMBIA RIVER BASIN**

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Program Measure Number: 704 (h) (2) D**

**Relationship to Program Measure:** Infectious diseases are responsible for devastating losses in Columbia River basin salmonids. Successful propagation and enhancement of the valuable fisheries resource of the basin rests upon the control of these diseases. The objective of this study, as part of Program Measure 704 (h)(2) D, is to investigate the epidemiology of three salmonid pathogens and establish measures for their control.

**Technical Results :** Infections caused by Ceratomyxa shasta were detected for the first time in the Snake River at Little Goose Dam. Strains of chinook and coho salmon and steelhead trout from Columbia River basin origins were all highly resistant to C. Shasta. Chinook salmon smolts were beach seined from the lower Columbia River immediately upstream of the estuary. These fish were held for 150 days in either fresh or salt water. The prevalence of C. shasta was higher in those fish held in fresh water (7% to 19%) as compared to salt water (0% to 3%).

**Results from holding chinook salmon smolts in either fresh or salt water after capture by beach seine in the lower Columbia River suggests that progress of bacterial kidney disease (BKD) accelerates after the smolts enter the salt water environment. The capture in the open ocean of clinically diseased salmonids infected with BKD indicates the existence of an ongoing mortality. Waterborne transmission in salt water of Renibacterium salmoninarum to chum salmon resulted after exposure to 10<sup>6</sup> viable bacteria for 30 minutes.**

**Laboratory trials with fish exposed to infectious hematopoietic necrosis virus (IHNV) resulted in the recovery by molecular filtration of approximately 65% of IHNV added to water. Injected IHNV survived for over two weeks without replication in unfertilized eggs, whereas, in eyed eggs, the virus not only survived but replicated and caused deaths among fry that hatched from these eggs. Results from transmission experiments c-t Round Butte Hatchery suggest that vertical transmission of IHNV, if it occurs, is a very infrequent and rare event. On three occasions, IHNV was detected in**

ovarian fluid samples after storage for 6 to 9 days at 4°C. No virus had been detected in these samples when collected at spawning. These observations raise the possibility that IHNV is much more widespread than previously thought and also that sampling procedures may require major modifications.

**Technical Review:** Results of these studies are subjected to peer review by other scientists in these fields.

**Evaluation of Effectiveness:** Effectiveness will be determined by increased survival, which leads to a greater return to the fisheries.

**Degree of Program Measure Fulfillment:** Methods developed in this project will need to be implemented and evaluated before the program measure can be fully addressed.

**ETIOLOGY OF EARLY LIFESTAGE DISEASES : WHITESPOT,  
COAGULATED YOLK, AND PINHEAD (DROPOUT)**

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Program Measure Number: 704 (h)(4)**

**Relationship to Program Measure :** Program Measure 704 (h)(4) calls for the development of methods to improve diagnosis and control of fish disease and parasites in hatchery facilities. The goal of this project is to identify bacteria grown from within eggs, establish which ones are pathogenic to hatchery-reared fish, determine drug sensitivities for the various bacteria, and determine if there is a common predictor of early lifestage mortalities.

**Three years of preliminary studies by OHSU revealed that:**

**A. Some brood females produce eggclots which suffer severe mortality rates (65% to 100%) during hatchery rearing, whereas other females produce eggclots which experience very low mortalities (less than 5%).**

**B. Bacteria could be seen microscopically within the yolk of eggs sampled from high mortality eggclots, and techniques were developed which allowed the culturing and isolation of bacteria known to have come from within surface-sterilized eggs.**

**C. The bacterial load carried by individual females varied greatly and led to the hypothesis that some female brood salmon are diseased and**

**produce eggs carrying bacteria within their yolk; these bacteria subsequently cause higher-than-normal mortality within such groups of eggs. This project is designed to define and develop methods to control the problem.**

**Technical Results:** Seventeen species of bacteria have been isolated, characterized, and identified from the 30 brood salmon and their progeny, which were followed through rearing. Five species of bacteria from within surface-sterilized eggs have been identified and two other isolates are in the process of being identified. Endotoxin levels in ovarian fluid have been determined, but the correlation with early egg mortalities is clouded by the additional presence of gram positive bacteria and the occurrence of soft shelling in two groups of eggs. It is hoped that endotoxin levels within eggs taken at spawning will prove to be a better predictor of early egg loss.

**Histologic preparations of eggs suffering whitespot reveal many bacteria deep within the yolk of the eggs. Early onset of fin rot is suspected by the presence of large quantities of blood outside the vascular bed of the fin. Pinheading can be seen as ulcerative changes in the intestinal tract, in some cases prior to hatching. This year's work and that of previous years strongly suggest that there is an annual variation in the bacterial profile of brood salmon and that additional species will be identified in future brood years.**

**Technical Review:** As needed, identifications of some bacterial isolates are confirmed by an independent laboratory.

**Evaluation of Effectiveness:** This project has been in progress less than nine months; however, our technique for surface sterilization and subsequent culturing of bacteria from within the yolk of eggs could be used by other investigators.

**Degree of Program Measure Fulfillment:** Information from this phase of the project should help us initiate efforts to break the cycle of vertical disease transmission by methods which could be used at or near spawning time.

**DEVELOPMENT OF HATCHERY PRACTICES AND ANTIVIRAL DRUGS  
TO CONTROL IHN VIRUS IN SOCKEYE AND CHINOOK  
SALMON AND STEELHEAD TROUT**

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BPA Project Number: 82-21  
Program Measure Number: 704 (h) (2) D**

**Relationship to Program Measure:** Program Measure 704 (h)(2) D states that BPA shall fund development of programs and methods to improve fish health protection by preventing the spread of pathogens, improve cultural methods, and minimize the impact of diseases on hatchery and wild stocks. This project has dealt with the major acute disease in the Columbia River basin, infectious hematopoietic necrosis (IHN) , to adapt and expand broodstock culling to production scale, to identify antiviral chemicals with potential for water hardening agents, to investigate routes of transmission of IHN virus, and to screen populations.

**Technical Results :** Broodstock culling, in which spawning fish are screened for virus and infected eggs are destroyed, was continued at several hatcheries with favorable results at most. Culling continues to be the only interventionist alternative to mass destruction of infected populations. Where culling has failed, routes of virus transmission other than vertical are indicated. Hatchery water supplies are the most obvious alternative source, but environmental virus (i.e. , that remaining in the hatchery from the previous epizootic) may also be a source. We have found that virus associates with sediment quickly and in measurable quantities. Such association may preserve infectivity for long periods of time and act as an abiotic reservoir of infection. Several candidate antiviral drugs have been identified. The receptor site on salmonid sperm that binds IHN virus has chemical characteristics resembling a lectin.

**Technical Review :** The adequacy of design will be reflected in the acceptance of publications by scientific journals.

**Evaluation of Effectiveness :** Broodstock culling has already received wide acceptance as a technique, and at least six fish virology labs are involved.

**Degree of Program Measure Fulfillment:** IHN continues to be a major threat to fish populations. Efforts should continue to develop better coping mechanisms.

**DEVELOPMENT OF A RAPID, SERODIAGNOSTIC TEST FOR THE  
DETECTION, SURVEILLANCE, AND DIAGNOSIS OF FIVE IMPORTANT  
PATHOGENS OF FISHES IN THE COLUMBIA RIVER BASIN**

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BPA Project Number: 83-304  
Program Measure Number : 704 (h) (2) D**

**Relationship to Program Measure:** Program Measure 764 (h)(2) D calls for improvements in detection, diagnosis, and control of fish diseases and parasites. This project deals with the development of improved detection techniques for five important diseases of salmonid fishes: two viruses, infectious hematopoietic necrosis (IHN) and infectious pancreatic necrosis (IPN), and three bacteria: Aeromonas salmonicida, Yersinia ruckeri, and Renibacterium salmoninarum .

**Technical Results:** The enzyme-linked immunosorbent assay (ELISA) has been the procedure of choice for the three bacterial diseases. Inadequate levels of sensitivity have thus far prevented the development of useful ELISAs for the two viral diseases, and effort on these pathogens has shifted to immunoblot techniques. Currently, the level of sensitivity in the immunoblot test is 4 ng of IHN virus antigen and 850 pg of IPN virus antigen. A specific antigen for A. salmonicida has been identified, and an ELISA which does not cross-react with A. hydrophila has recently been developed. The ELISA test for R. salmoninarum is currently being field tested and appears to be far more sensitive than other assays for this pathogen.

**Technical Review :** The adequacy of the design and execution will be reflected in the acceptance of professional publications derived from this project by scientific journals .

**Evaluation of Effectiveness :** The effectiveness of this project might be judged by its eventual contributions to the scientific literature, by the extent of experimental effort to determine if rapid tests can be developed, and by the offer and introduction of such tests.

**Degree of Program Measure Fulfillment:** Because of constantly changing technology, development of new formats of pathogen detection procedures should be viewed as an ongoing effort.

## **DEVELOPMENT OF A VACCINE FOR BACTERIAL KIDNEY DISEASE IN SALMON**

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Program Measure Number: 704 (h)(4)**

**Relationship to Program Measure:** Program Measure 704 (h)(4) calls for the improved propagation of existing facilities via disease control. The goal of this project is to produce a vaccine for bacterial kidney disease (KDB) of salmonids. Such a vaccine would reduce or eliminate losses of hatchery-reared fish due to bacterial kidney disease. This vaccine would increase the efficiency of fish propagation under Program Measures 704 (i and j) and produce immune fish that would make safer candidates for the supplementation of naturally spawning stock (Program Measure 704 k).

**Technical Results:** Renibacterium salmoninarum antigens have been extracted by ammonium sulfate, heat, and by sonication. Rabbits have been immunized with all three of these antigenic preparations and with formalin-killed cells. Sera from these rabbits have been used to test the antigenic activity to be found in the extracts. Considerable activity has been found in the heat extract and sonicates as evidenced by multiple immunodiffusion bands.

It is of great interest that antisera to sonicates recognize the soluble antigen found in saturated ammonium sulfate precipitated extracts of KDB culture supernatants, while antisera produced to formalin-killed cells cannot recognize this antigen. This preliminary evidence suggests that R. salmoninarum is secreting large amounts of a protein or glycoprotein (as determined by protein and carbohydrate assays). The question then arises as to the function of this material. If this material is an exotoxin, it would be best to try to develop a toxoid from it for immunization purposes. Before this type of modification is attempted, the material will be tested for potential toxicity in vitro fish cell culture assays and in vivo.

Mice have been immunized with extracts and have demonstrated positive titer, as determined by a kinetic-based ELISA system for the detection of anti-KDB antibodies. These mice are currently being used for the production of monoclonal antibodies with KDB.

A component of Vibrio anguillarum cell wall, which does not appear to be lipopolysaccharide, possesses the ability to non-specifically activate salmon lymphocytes to produce antibody. Further in vitro tests of its activity are being run before this material is used in conjunction to KDB antigens as a immunostimulatory reagent.

**Technical Review:** Not currently applicable.

**Evaluation of Effectiveness:** Not currently applicable.

**Degree of Program Measure Fulfillment:** The control of diseases at our hatcheries is a major problem. The product of this project should aid in the partial fulfillment of this measure by increasing survival in the hatchery and by increasing the returns for spawning. After the bacterial kidney disease problem has been resolved, however, it will be essential to turn our attention to &her, as yet unresolved. fish disease problems.

**SURVEY OF ARTIFICIAL PRODUCTION OF ANADROMOUS  
SALMONIDS IN THE COLUMBIA RIVER BASIN**

**Dr. George Y . Harry, Jr., Project Leader  
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BPA Project Officer: Ron Morinaka  
BPA Project Number: 84-51  
Program Measure Number: 704 (f)**

**Relationship to Program Measure:** Program Measure 704 (f) requires the compiling and archiving of information on existing or potential sites for anadromous fish propagation facilities in the Columbia River Basin. Data on equipment and facilities, water quality, and biology are also being collected.

**Technical Results:** Seventy-four of the 78 Columbia River Basin Propagation facilities that were contracted for study have been surveyed. A draft report, "Survey of Artificial Production of Anadromous Salmonids in the Columbia River Basin" has been submitted to BPA. The document details the methods used to collect the survey data and includes a review of pertinent literature. The written forms used to collect data have been incorporated into a computer data base (R Base 4000) and will be transferred. to a RIM data base on the BPA mainframe computer.

**Technical Review :** This contract provides for data collection and archiving only. BPA staff reviewed both the proposed survey methods and the literature review before field work began. No analysis of data is contemplated under the existing contract.

**Evaluation of Effectiveness :** Our engineers collection 'and review all data at each facility. This results in uniform data format, quality, and availability . Biological data are also collected onsite, but also incorporate agency data. Some data are subject to reformatting, as no two agencies collect the same data with the same format or frequency. In some instances, we have noticed considerable differences in data gathered at the facility sites as opposed to the same data obtained from the agencies' central repositories.

Attention to standards in formatting biological data could help to reduce problems in reporting and recording. The second issue, variation in biological data from "source" to "outlet," may reflect agency accounting and policy best dealt with on a regional basis; the difference in these data suggest the need for uniform standards for evaluating real fish production.

**Degree of Program Measure Fulfillment:** At the completion of this contract in its present form, privately owned facilities and approximately 10 agency-operated facilities (recently completed) will not have been included in the survey.

### **COMPENDIUM OF LOW-COST PACIFIC SALMON AND STEELHEAD TROUT PRODUCTION FACILITIES IN THE PACIFIC NORTHWEST**

**Harry Senn, Project Leader  
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BPA Project Officer: Gerald Bouck  
BPA Project Number: 83-353  
Program Measure Number: 704 (j)(l)**

**Relationship to Program Measure:** The purpose of this project was to investigate low capital-cost salmon and steelhead trout production facilities and identify those that conform with management goals for the Columbia basin. To a large extent, the study was deemed necessary because natural production in the Columbia basin is critically low in certain areas. The species considered were chinook salmon (Oncorhynchus tshawytschal , coho salmon (O. kisutch) , sockeye salmon (O. nerka) , and steelhead trout (Salmo gairdneri).

**Technical Results :** A comprehensive report listing the facilities, techniques, and equipment used in artificial production in the Pacific Northwest was completed. Information in the report is sufficiently detailed to assist hatchery managers and administrators in making facility choices that will help restore fish runs at the lowest possible cost.

Data were compiled through a literature search, site visitations, and personal communications with knowledgeable hatchery personnel. Over 80 state, federal, and tribal facilities in Oregon, Washington, Idaho, and British Columbia were visited, and additional information was obtained from Alaska Fish and Game, Alaska Salmon Ranchers, and Norway. Approximately 150 hatchery administrators, managers, biologists, and technicians were also consulted. Over 250 vendors of fish culture-related materials and equipment were solicited, and those responses that were applicable are noted.

The appendices contain lists of vendors and production facilities visited, a representative check-list of tools and equipment frequently used at a fish culture facility; job descriptions for hatchery personnel required at low-cost facilities, and examples of the methods we used to determine rearing space for prototype stations.

**Technical Review:** The report was technically reviewed by the National Marine Fisheries Service at the request of BPA. Segments of the report were reviewed by the Fish Facility Work Group of the Salmon and Steelhead Enhancement Conservation Act.

**Evaluation of Effectiveness :** The report has been published and is being used as a reference document by fish culturists and administrators.

**Degree of Program Measure Fulfillment:** Program Measure 704 (j) (1) was fulfilled by publication of the report.

#### **STOCK IDENTIFICATION OF COLUMBIA RIVER CHINOOK SALMON AND STEELHEAD TROUT**

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BPA Project Officer: Gerald Bouck  
BPA Program Number: 83-451  
Program Measure Number: 704 (h) (2) C**

**Relationship to Program Measure :** Program Measure 704 (h)(2) C states that Columbia River spawning stocks shall be assessed to ensure proper use of stocks so that genetic integrity is maintained. The goal of this project is to provide the information necessary to maintain genetic integrity and optimize production potential of Columbia basin stocks of chinook salmon and steelhead trout. Specifically, this project will characterize hatchery and wild stocks of chinook salmon and steelhead trout by using gene frequencies (electrophoretic characters) and anatomical characters (taxonomic counts and measurements). In addition, we will use these characteristics to provide estimates of relative heterozygosity . We will combine our data with life history data provided by the Stock Assessment study and determine the similarities of the various stocks so as to provide guidelines for making management decisions on stock transfers.

**Technical Results:** Electrophoretic analyses of 36 stocks of steelhead trout and 38 stocks of chinook salmon have been completed. Morphological analyses of these stocks are under way and should be completed by next summer .

**Relative heterozygosity values for steelhead were slightly higher for winter than for summer stocks. No significant difference was found between relative heterozygosity values for hatchery and wild steelhead. In addition, relative heterozygosity among steelhead remained constant for hatchery and wild stocks throughout the study area. Among races, summer chinook had the highest and spring chinook the lowest relative heterozygosity. While relative heterozygosity of all stocks of chinook varied slightly throughout the study area, hatchery-reared chinook had higher levels of heterozygosity than did wild chinook.**

**The cluster analysis for the chinook stocks had strong geographical tendencies and some, but not complete, separation between races of chinook. The cluster analysis of steelhead stocks suggests that stocks of common areas are similar. The analysis does not show any separation between summer and winter steelhead stocks. Anatomical and life history data will be incorporated into our final analysis, and this may provide a basis for separating the winter and summer races. We will also characterize the stream systems and correlate Columbia River sub-basin classification to our characterization of stocks. We believe that possible reasons for stock differences will emerge from this technique.**

**Technical Review: Methods and designs for these studies were reviewed and approved by the Oregon Department of Fish and Wildlife and the National Marine Fisheries Service.**

**Evaluation of Effectiveness: This study will characterize the various stocks for electrophoretic and anatomical characteristics. In addition, the analysis of similarities among the stocks should provide a basis for 1) identifying stocks requiring unique management decisions, 2) protecting the genetic integrity of the existing stocks, and 3) selecting donor stocks for depleted runs.**

**Degree of Program Measure Fulfillment: This project will complete the assessment of electrophoretic and anatomical characteristics to provide a relative measure of heterozygosity among stocks.**

## **EVALUATION OF LOW-COST SALMON PRODUCTION FACILITIES**

**James M. Hill, Project Leader  
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BPA Project Officer: Thomas Clune  
BPA Project Number: 83-364  
Program Measure Number: 704 (j)(1)**

**Relationship to Program Measure: This project addresses Program Measure 704 (j) (1) to develop and test small-scale, low-cost salmon and steelhead propagation facilities adaptable to Columbia basin locales. The CEDC Fisheries Project is an existing low-cost facility that will be evaluated with**

respect to the feasibility of implementing similar programs in other areas of the Pacific Northwest. Evaluation of CEDC's smolt release strategies will also provide information relevant to Program Measure 704 (h) (5), which call8 for the development of a smolt survival index.

**Technical Results :** Fiscal year 1984 was the second year of the five-year study. Specific objective8 of 1984 were to investigate the potential for community involvement, initiate the evaluation of smolt release strategies, and provide the cumulative production of large numbers of quality salmon.

Community involvement in the construction phase of the rearing facility through in-kind and cash contribution8 amounted to 40% of the total estimated cost . . Support ranged from 35% to 89% of total construction costs for each of the three earthen rearing ponds. Community involvement in annual operation and maintenance activites was 15% and 28% of the 1983 and 1984 annual operating budgets, respectively.

CEDC's smolt release strategy make8 use of the volitional migration of smolts from the ponds. Cursory result8 indicate larger ooho smolts (9.5 fish per pound) migrate predominately during periods of increased flow8 irrespective of daylight conditions, whereas smaller smolts (16.3 fish per pound) migrate during darkness irrespective of. flows. Migration extended over a three-week period. Fall chinook outmigration continued for ,a six-week period with comparative length-frequencies of migrating smolts and pre-release smolts the same. The chinook started entering the tidewater estuary four miles below the release site six days after release.

**Technical Review:** The CEDC Fisheries Project is part of a cooperative agreement with the Oregon Department of Fish and Wildlife and, hence, personnel collaborate in all aspect8 of production and research activities.

**Evaluation of Effectiveness :** A three-year coded-wire tagging program was implemented in the first year of the project. Subsequent annual tag recoveries will be used to evaluate the effectiveness of salmon. releases from CEDC facilities. Coho were caught in Washington, Oregon, and California fisheries. Contributions to the fisheries by CEDC coho release8 were 0.5% and 2.2% of release numbers in 1983 and 1984, respectively. Fall chinook were harvested in the Canadian, Washington, Oregon, and Young8 Bay fisheries with catch percentage8 of 61.9, 19.0, 1.3, and 17.1, respectively, in .the 1983 fishery.. Only one year was included in the' contribution values for 1980-brood fall chinook, amounting to .0. 2% of the release number harvested.

**Degree of Program Measure Fulfillment:** After the five-year program ha8 been completed, CEDC will evaluate the impact of community involvement, the effectiveness of the smolt release strategy, the optimum density level8 for earthen rearing ponds, and the cumulative production and evaluation of large numbers of quality salmon from the facility. This will complete CEDC's objective to demonstrate the feasibility of implementing other 8imilar facilities in other areas of the Columbia Basin.

**DEVELOPMENT OF RATIONS FOR THE ENHANCED  
SURVIVAL OF SALMON**

**David L. Crawford, Project Leader  
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BPA Project Officer: Thomas Clune  
BPA Project Number: 83-363  
Program Measure Number : 704 (h) (2)**

**Relationship to Program Measure:** Program measure 704 (h)(2) is directed toward research, development, and demonstrations that improve husbandry and survival of fish to adulthood. The objective of the project is to establish the influence of feed regimes composed of high quality animal components on the efficiency of hatchery production and the survival and return of coho and chinook salmon to the Columbia River system. Improved artificial production would be better able to reestablish the vigor of natural runs of salmon in the Columbia River and its tributaries and maintain and improve the genetic integrity of specific stocks.

**Technical Results :** Laboratory-scale feeding trials defined the growth response of young salmon to vacuum dried and hydrolysed spray-dried proteins relative to commercial fish meals. Rations prepared from vacuum-dried products of salmon meal were consumed and converted in a superior manner to those of vacuum-dried hake and commercial flame-dried herring meal. Vacuum drying did not have an advantage over steam-tube drying for growth. Hydrolysed and spray-dried fish produced a better growth response than intact proteins. A test of the "soft dry" ration concept revealed it to be inferior to "moist" rations.

**Enhancing component8 such as pasteurized krill, beef liver, tuna viscera, shrimp and squid were evaluated in test8 with laboratory starter ration. Vacuum and steam-tube dried meals of salmon and hydrolysed spray-dried salmon produced superior gain and conversion. Vacuum-dried intact hake was inferior to salmon sources of protein, but its hydrolysed counterpart was equivalent. Rations composed of hydrolysed spray-dried ground fish carcass waste and a commercial hydrolysed product produced inferior growth and conversion to all other sources of protein. "Wet" ration enhancers did not improve acceptance over water in combination with hydrolysed spray-dried products, which were highly acceptable.**

**Hatchery-scale survival investigations were completed with coho salmon at the Oregon Department of Fish and Wildlife Sandy Hatchery and with fall chinook salmon at their Bonneville Hatchery. Duplicate ponds of 1982-brood coho (Sandy stock) of 58,000+ fish each were reared on a control ration (Oregon pellet) and test rations containing major protein fraction of vacuum-dried salmon carcasses and Pacific hake from 27 June 1983 to release on 30 April 1984. Between 25-27,000 tagged fish were released from each pond. Rations containing vacuum-dried salmon and hake produced equal sized fish through superior feed conversion of less feed.**

**Vacuum-dried salmon meal rations yielded protein conversion rates superior to the control and vacuum-dried hake rations; the latter were equal.**

**Duplicate ponds of 1983-brood fall chinook (tule stock) of 600,00+ fish each (thinned to 274-278,00 on 24 February 1984 at 1.7 to- 1.9 g/fish) were reared on a control ration (Oregon pellet) and a test ration containing a major protein fraction composed of vacuum-dried salmon meal (1/32" pellet sizes contained hydrolysed and spray dried salmon) from 29 December 1983 to release on 8 May 1984. Between 80-82,000 tagged fish were released from each pond. Test rations produced larger fish through superior conversion of slightly less feed. The quantity of test ration (dry wt. ) and ration protein to produce a unit body weight and -protein gain was 80.2% and 90.6% of the control ration, respectively. Test ration fish experienced fewer mortalities (NS) and possessed a slightly higher (NS) body fat content and blood hematocrit (112.7% of control) upon release than control fish.**

**Technical Review: The design of the hatchery-scale survival tests have been technically reviewed by the Oregon Department of Fish and Wildlife.**

**Evaluation of Effectiveness : The effectiveness of this project will be determined by the degree to which rations containing quality animal protein complements will enhance survival in a cost-effective manner. Positive results will provide guidelines that could be used to formulate feeding procedures applicable to other hatchery ration systems.**

**Degree of Program Measure Fulfillment: Improvement of hatchery husbandry for efficiency and survival of released fish is a broad program measure of which nutrition is but one facet. Development of sources of high quality protein and their introduction into commercial ration systems would demonstrate that survival can be enhanced by high quality test rations.**

## **EFFECTS OF PLOW ON MIGRATORY BEHAVIOR AND SURVIVAL OF JUVENILE FALL AND SUMMER CHINOOK**

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BPA Project Officer: Tom Vogel  
BPA Project Number: 81-1  
Program Measure Number: 304 (d)(1)**

**Relationship to Program Measure: The National Marine Fisheries Service, in cooperation with BPA, is conducting a six-year study of the effects of instream river flow on the passage time, survival, and migrational behavior of juvenile fall and summer (O-age) chinook salmon in John Day Reservoir.**

**This project was initiated in 1981 and is scheduled for completion in 1987. The remaining work will involve the collection and analysis of adult tag returns. Results of the project are applicable to Program Measure 304 (d) (1).**

**Technical Results: Fifty-one groups (209, 129 fish) of. marked O-age chinook salmon were wire-tagged, branded, and released into the tailrace at McNary Dam from 1981 through 1983. An additional 88 groups (49,080 fish) were branded and released into the reservoir at various other sites.**

**Sampling at John Day Dam, using the airlift pump system in the B and C slots of Turbine Intake Unit 3, captured 200,562 subyearling chinook salmon including 1,745 mark recoveries. Additional marks (1,145) were recovered from purse seine samples taken at various sites throughout the reservoir.**

**Weekly mean fork lengths of O-age chinook salmon captured at McNary and John Day dams and in the reservoir by purse seine ranged from 103 mm in mid-June to 166 mm in mid-December. Analysis of stomach samples taken in 1982 and 1983 from purse seine catches indicates active feeding is taking place in the reservoir.**

**The average reservoir residence time (calculated from the median date of the mark recoveries from each group at John Day Dam) was 22.5 days.**

**Regression analysis was used on data from 1981 through 1983 to develop a description of the relationship of the rate of downstream movement (Y) of O-age chinook salmon in John Day Reservoir to river flow (X) :**

$$Y = 22.32 + 0.0099 X$$

**The slope of this line was not significantly different from zero at the 95% level of confidence. Therefore, the hypothesis that the rate of movement of O-age chinook salmon through John Day Reservoir is related to flow is rejected.**

**Technical Review: Drafts of project results are submitted to BPA for distribution to appropriate technical reviewers.**

**Evaluation of Effectiveness : This program has established that there is no correlation between fish movement and amount of flow provided in the reservoir.**

**Degree of Program Measure Fulfillment: We are in the process of evaluating the adult returns and will continue to do so through 1987.**

**SMOLT PASSAGE BEHAVIOR AND FLOW-NET  
RELATIONSHIPS IN THE FOREBAY OF JOHN DAY DAM**

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BPA Project Officer Tom Vogel  
BPA Project Number 82-8  
Program Measure Number: 304 (d)(1)**

**Relationship to Program Measure:** This research project was initiated before the Fish and Wildlife Plan was adopted; however, the project has been aligned to address Program Measure 364 (d)(1). The project involves monitoring current patterns, defining fish distribution with purse seine sampling, and assessing the value of a new application of radio-tag methodology designed to examine passage behavior of juvenile salmonids.

**Technical Results :** Preliminary results from the purse seining operations in FY84 support observations made in 1983; that is, the discharge from the John Day River and the turbid plume it forms in the forebay may have a pronounced effect on the distribution of smolts as they approach the dam. These data suggest that the plume may be shunting salmon toward the Washington (spill) side of the river where they could be more susceptible to spill passage. These findings are being analyzed in conjunction with 1983 data and will be detailed in the final report in FY85. Data describing the current patterns during 1983 and 1984 will be incorporated into an overall analysis of the relations of current patterns and John Day River discharge to fish migration patterns.

A new research application of radio-tag methodology was successfully executed. From 57% to 100% (average = 79%) of the individuals in various groups of spring chinook salmon smolts fitted with radio tags released 6 km upstream from John Day Dam successfully migrated to and were detected at the dam. Furthermore, it was possible to positively identify the specific passage route (spillway, powerhouse, fish ladder, or navigation lock) used by each uniquely coded individual. Results are being evaluated in light of data generated from the other phases of the program,

**Technical Review :** Drafts of project results are submitted to BPA for distribution to appropriate technical reviewers.

**Evaluation of Effectiveness :** Effectiveness will be determined by answering the question of whether or not smolt migratory behavior is correlated with dam operations and river flow conditions. We will be able to answer this question after the study has been completed in 1985.

**Degree of Program Measure Fulfillment:** Applicability of conducting similar work at other facilities will remain to be evaluated in this program measure.

## **PEN REARING AND IMPRINTING OF FALL CHINOOK SALMON**

**William R. Nelson and Curtis L. Burley, Project Leaders  
U.S. Fish and Wildlife Service**

**Willard Field Station (SNFRC), Cook, Washington 98605, (509) 538-2299**

**BPA Project Officer: Ron Morinaka**

**BPA Project Number: 83-313**

**Program Measure Number: 704 (j) (1)**

**Relationship to Program Measure: Program Measure 704 (j)(1) requires the development of small-scale, low-cost test facilities for rearing salmon and steelhead in the Columbia River basin. These "off-station" facilities will also include temporary acclimation ponds that may be used to facilitate imprinting and acclimation of fish prior to release [Program Measure 704 (j)(2)].**

**The purpose of this project is to study how survival and homing of hatchery-produced salmonids, released at sites upstream from the respective hatcheries of origin, may be enhanced by rearing the fish at intended release points for a period of time in these temporary facilities. Currently, the salmonids are hauled directly from the hatchery to upstream sites for immediate liberation. Total hatchery production may also be increased if traditional thinning releases, as the fish grow and require additional hatchery space, could be transferred to the "off-station" facilities rather than released at an early developmental life stage [Program Measure 704 (h)(1)].**

**Technical Results : During 1983, potential rearing area in reservoir backwaters and ponds along the Columbia River from Priest Rapids Dam to John Day Dam were surveyed. The best sites found for rearing trials were Social Security Pond (river km 468) and Rock Creek backwater (river km 367), both located in John Day Reservoir.**

**In 1984, juvenile chinook salmon were reared at various density and feeding combinations in net-pen enclosures at both sites and in a barrier net at Rock Creek from mid-April until release in mid-June. Growth, survival, and disease of test fish were monitored to determine optimum rearing strategies including holding densities, feeding rations, and release times.**

**Growth rates were highest in all enclosures during the first 2 to 4 weeks after stocking. Growth was faster and smoltification peaked at an earlier date among test fish than among the same stock of fish held in the hatchery. Mortality was within "acceptable" limits (<0.1% per day) until water temperatures reached about 15°C. A coincident increase in disease was noted at that time due to enteric redmouth disease (after 6 to 7 weeks of rearing); however, the fish were successfully treated with TM-50 prior to release. Fish stocked in April at about 2.0 g/fish (225 fish/lb) were released in June at about 6.5 g/fish (65 to 70 fish/lb).**

**Technical Review:** Project reports will be submitted to BPA for dissemination to appropriate technical reviewers. Results are also reviewed at annual BPA project presentations.

**Evaluation of Effectiveness:** The cost/benefit of rearing fish in "off-station" facilities will be compared with more traditional hatchery methods.

**Degree of Program Measure Fulfillment:** In future studies (1985 to 1987), test fish will be reared at the density and feeding combinations judged to produce the most fish (measured on the basis of full hatchery ration and release weight), and adult returns will be monitored and evaluated (1985 to 1990). A management plan for low-capital salmon production programs will also be developed in future work.

**DISTRIBUTION, LOCAL ABUNDANCE, COMMUNITY STRUCTURE,  
GROWTH RATE, AND MORTALITY RATE OF NORTHERN SQUAWFISH,  
WALLEYE, AND SMALLMOUTH BASS IN THE JOHN DAY RESERVOIR**

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BPA Project Officer: Fred Holm  
BPA Project Number: 82-12  
Program Measure Number: 404 (c)(1)

**Relationship to Program Measure:** This project, in response to Program Measure 404 (c)(1) of the Fish and Wildlife Plan, will estimate the percentage of juvenile salmonids lost to predation during downstream migration. Seasonal changes in distribution will be described, and estimates will be made of abundance, age composition, and rates of growth and mortality of northern squawfish, walleye, and smallmouth bass in John Day Reservoir. A model of the effects of predation on juvenile salmonids in John Day Reservoir will be developed, and the feasibility of regulating predation by major predators on juvenile salmonids will be examined.

This project is part of a cooperative study by Oregon Department of Fish and Wildlife (ODFW) and the U.S. Fish and Wildlife Service (USFWS).

**Technical Results:** Abundances of northern squawfish, walleye, and smallmouth bass in John Day Reservoir in 1984 were estimated using a modified Schnabel multiple mark and recapture estimator. Estimated abundances were 80,486 northern squawfish, 15,822 walleye, and 4,387 smallmouth bass.

Northern squawfish were distributed throughout the reservoir and in John Day River. Walleye were most abundant less than 25 miles downriver of

**McNary Dam (in the upper one-third of the reservoir). Smallmouth bass were distributed in two discrete areas, a 30-mile-long stretch from John Day Dam upriver to near Arlington (including John Day River) and a 1&mile-long stretch from McNary Dam downriver to Paterson Slough. Radiotagged walleye and northern squawfish appeared to use backwater areas (<3 m) in the spring during high flows, but then moved offshore into deeper water (>5 m) in July when spill ceased and water temperatures increased. In mid-July, radiotagged northern squawfish moved upriver to McNary Dam and were located near the turbine outflow. Correspondingly, catches of northern squawfish at the dam increased notably in July.**

**Technical Review : Project sampling design and data analysis techniques have been technically reviewed by biologists from various agencies including ODFW, USFWS, BPA, and the Northwest Power Planning Council. Critical comments have been solicited during annual project reviews.**

**Evaluation of Effectiveness: Results from our project will be incorporated with results of USFWS studies to estimate the magnitude of losses of juvenile salmonids to predation and identify biologically effective measures to reduce those losses. Future work based upon knowledge gained by our project would include implementing and evaluating selected predation control measures in John Day Reservoir and gathering data necessary to use our model to evaluate effects of predation on juvenile salmonids in other Columbia River basin reservoirs.**

**Degree of Program Measure Fulfillment: Upon completion of our project, the importance of predation as a cause of juvenile salmonid mortality in John Day Reservoir will be documented.**

**FEEDING ACTIVITY, RATE OF CONSUMPTION, DAILY RATION AND PREY SELECTION OF MAJOR PREDATORS IN THE JOHN DAY POOL**

**Gerard A. Gray and William R. Nelson, Project Leaders  
U.S. Fish and Wildlife Service**

**Willard Field Station (SNFRC) , Cook, Washington 98605, (509) 538-2299**

**BPA Project Officer: Fred Holm**

**BPA Project Number: 82-3**

**Program Measure Number: 404 (c) (1)**

**Relationship to Program Measure : Program Measure 404 (c)(1) directs BPA to continue its existing study and fund any further studies necessary to investigate juvenile salmon and steelhead losses to predators while the fish are migrating through the Columbia and Snake river reservoirs. This project is conducted to estimate the average consumption (BPA Project 82-3) and abundance (BPA Project 82-12) of northern squawfish, walleye, smallmouth bass, and channel catfish in the John Day Pool, a mainstem Columbia River reservoir.**

**Technical Results :** Research to estimate consumption was begun in April 1982 and will continue through 1986. Predatory fish were collected annually from April through August over the diel period at tailrace, mid-reservoir, and forebay stations. Prey fish found in stomachs were identified to species. Preliminary results from dietary analysis suggest that predation by northern squawfish is most intense immediately upstream and downstream of dams where juvenile salmonids are delayed and funneled through bypass facilities. Predation has, however, been observed among all species throughout the reservoir, but at a reduced level. Consumption rates will be estimated by comparing digestion of stomach contents of fish collected in John Day Reservoir with digestion of fish under controlled laboratory conditions.

**Technical Review:** A consultant from Oregon State University is reviewing the statistical design and treatment of the data. A report of the results will eventually be submitted to fish and wildlife agencies for technical review and comment. Portions of the study have been submitted to various technical journals for publication.

**Evaluation of Effectiveness :** Effectiveness will be determined by acceptance and implementation of the results and recommendations by agencies responsible for managing the fisheries resource.

**Degree of Program Measure Fulfillment:** Effects of predation have been evaluated only at one location during high flow years. Therefore, similar studies may be required at this and other study locations for low flow years. Studies to develop management practices and evaluate their effectiveness may also be required to meet the intent of the program measure.

#### **WATER BUDGET MANAGEMENT**

**Mark W. Maher, Project Leader  
Pacific Marine Fisheries Service  
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BPA Project Officer: Richard Harper  
BPA Project Number: 83-536  
Program Measure Number: 304 (a,b,c)**

**Relationship to Program Measure:** The Northwest Power Planning Council was charged with development of two long-range programs, one for energy planning and one for fish and wildlife protection. Both plans have been completed and are being implemented.

The Columbia Basin Fish and Wildlife Program was developed to protect, mitigate, and enhance fish and wildlife affected by the development, operation, and management of hydroelectric facilities on the Columbia River

and its tributaries. An integral part of the Program is the Water Budget. Measure 304 (a) establishes and describes usage of the Water Budget. Measure 304 (b) establishes two Water Budget managers to implement 304 (a), and Measure 304 (c) specifies the coordination process that shall occur with the owners and operators of the hydro generating facilities.

**Technical Results :** The Water Budget is a volume of water, stored in four federal reservoirs and one private reservoir, to be used in aiding the downstream migration of juvenile salmonids. The Water Budget is managed the state and federal fish and wildlife agencies and tribes. Implementation of the Water Budget has decreased the firm energy load carrying capability (FELCC) by approximately 300 MW. Other system uses (e.g., irrigation, recreation, and navigation) are not affected by the Water Budget.

**Technical Review :** Not applicable.

**Evaluation of Effectiveness:** Effectiveness studies are conducted under BPA Project 80-1.

**Degree of Program Measure Fulfillment:** This is the second year of Water Budget implementation. The budget is ongoing and is now an integral part of coordinated system planning by BPA and the U.S. Army Corps of Engineers.

#### **WATER BUDGET MANAGER, COLUMBIA BASIN TRIBES**

**Malcolm Karr, Project Leader  
Columbia River Inter-Tribal Fish Commission  
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BPA Project Officer: Richard Harper  
BPA Project Number: 83-491  
Program Measure Number : 304 (b)**

**Relationship to Program Measure:** Program Measure 304 (b) creates a position to provide the Columbia Basin Tribes with expert assistance "to ensure that requirements for fish are made a part of river system planning and operations." The Tribal Water Budget Manager acts on behalf of the tribes in managing the water budget and implementing other applicable measures related to fish passage and survival. A recently added function is to organize and conduct periodic coordination meetings of the 12 Columbia Basin Tribes.

**Technical Results :** The tribal water budget manager is directly involved in the development and implementation of three major activities: the annual water budget implementation plan; the detailed fishery operating plan, which was developed for fishery agencies and tribes and covers all aspects of adult and juvenile fish passage; and the smolt monitoring program, which

**guides system operations and provides for evaluation of the effectiveness of actions taken.**

**Technical Review:** Project results are reviewed and approved by fishery agencies and the 12 Columbia Basin Tribes before implementation.

**Evaluation of Effectiveness :** Effectiveness evaluations are part of the process *which* requires several years of experience to properly assess. The ultimate measure of effectiveness will be the success in increasing juvenile salmon and steelhead survival and, in turn, the numbers of returning adults.

**Degree of Program Measure Fulfillment:** This is a continuing program measure with no defined end point.

#### **1984 SMOLT MONITORING PROGRAM**

**Willis E. McConnaha, Project Leader  
Water Budget Center**

**2705 E. Burnside, Suite 213 (503) 230-4287, Portland, Oregon 97214**

**BPA Project Officer: Richard Harper**

**BPA Project Number: 80-1**

**Program Measurement Number: 304 (d)(2)**

**Relationship to Program Measure:** Program Measure 304 (d) ( 2) calls for a smolt monitoring program to collect information on the migrating characteristics and survival of the various stocks of salmon and steelhead within the Columbia Basin. The program is conducted by the Water Budget Center under the direction of fish and wildlife agencies and the 12 Columbia Basin Tribes. Real-time information on smolt movement will guide management of the water budget and other systems operations. The data will also be used to index the migration characteristics of the annual outmigration and facilitate yearly migration comparisons. Migrational characteristics that are determined annually include smolt arrival time and migration duration, travel time, and survival.

**A primary objective of the Water Budget Center (WBC) Smolt Monitoring Program is to develop a basin-wide data management system that provides rapid access to data and facilitates post-season analysis of the migration.**

**Technical Results:** Migrational information was collected from traps above Lower Granite Dam and from hydroelectric projects at Lower Granite, McNary , Wells, Rock Island, Priest Rapids, and John Day.

**The 1984 spring chinook outmigration in the Snake River peaked at Lower Granite on May 2. Ten percent of these fish migrated past the dam on April 20, 50% on May 1, and 90% on June 10. Duration of the migration (time between the 10% and 90% dates) was 51 days. The steelhead migration**

peaked at Lower Granite on May 15. Timing of the migration at Lower Granite for steelhead was 10% on April 30, 50% on May 15, and 90% on June 2.

Not enough information was obtained from the mid-Columbia sites to characterize the migration by species through this reach.

The 1984 yearling chinook migration at McNary peaked on May 21. Timing of the migration was 10% on April 23, 50% on May 11, and 90% on May 25. Duration of the yearling migration was 32 days. Steelhead peaked at McNary on May 22. Ten percent of the migration had passed on April 27, 50% on May 19, and 90% on June 5.

Analysis of data regarding travel time and survival of specific mark groups has not been completed.

**Technical Review :** Design and oversight of the program is by the Water Budget Center (WBC) . Policy and technical input is provided by the fishery agencies and tribes. Additional technical advice is obtained from the Biometrics Work Group convened by the WBC. This group is composed of biometricians from several different agencies and offices. Field work is conducted by the Public Utility Districts, the National Marine Fisheries Service, private contractors, and the Idaho Department of Fish and Game.

**Evaluation of Effectiveness :** Data collection and dissemination are ongoing. The project is designed to be an annual monitoring management tool. Data from the monitoring project will be used in evaluating the water budget and other programs.

**Degree of Program Measure Fulfillment:** This project fulfills that portion of Program Measure 304 (d) (2) which calls for continued information on smolt survival and migration in the Columbia Basin.

#### **HYDROACOUSTIC MONITORING OF DOWNSTREAM MIGRANT SALMON AND STEELHEAD AT WELL DAM IN SPRING 1984**

**Gary E. Johnson and Colleen M. Sullivan, Project Leaders**

**BioSonics, Inc. , 4520 Union Bay Place N .E.**

**Seattle, Washington 98105, (206) 527-0905**

**BPA Project Officer: Dick Harper**

**BPA Project Number: 84-15**

**Program Measure Number: 304 (d)(2) A**

**Relationship to Program Measure:** The downstream migration of salmon and steelhead was monitored at Wells Dam from April 2 to June 15, 1984 as part of the Water Budget Center's (WBC's) smolt monitoring program. Program Measure 304 requires the Water Budget Center to coordinate monitoring of smolt movement to determine the best timing of storage releases. Because a

key part of implementing the Water Budget is knowing when the smolts are present, each day during the monitoring period an index of smolt passage at Wells Dam was reported to the WBC. The purpose of this study was to provide the WBC in-season data on the timing and duration of smolt passage at Wells in spring 1984. Wells is an appropriate monitoring location because smolt passage peaks there can be useful in anticipating smolt movement at downstream dams on the mid-Columbia.

**Technical Results :** Smolt passage at Wells in spring 1984 was monitored using fixed-location hydroacoustic techniques. Hydroacoustic data were supplemented with species composition data obtained with a turbine intake fyke net. The first substantial increase in the smolt passage index (number of fish per day per sampling station) occurred on April 25. This surge was caused by the release of over 600,000 spring chinook on April 23 from the Winthrop National Fish Hatchery on the Methow River 50 miles upstream from Wells. Smolt passage peaked on May 2 and was uniform during most of the month. The spring outmigration of salmon and steelhead was probably completed by the end of May; a fyke net sample on June 4 caught few chinook, steelhead, or sockeye. The unexpected peak in run size that occurred from May 29 to June 2 could have been caused by juvenile mountain white fish. This was the first year run timing was monitored into June at Wells.

Fyke net data showed that chinook passage probably peaked in late April; steelhead peaked in the first two weeks of May; and sockeye passage was variable throughout late April and May. Chinook dominated the net catch in late April and sockeye dominated in mid-May.

The hydroacoustic data indicated that most downstream migrants were distributed high in the water column and toward the western end of the dam. Over the entire sampling season, average hourly passage rates for day and night were similar, but more smolts passed the dam during the longer period of daylight than the shorter period of darkness. Data from the period when chinook dominated showed that passage rates were greater during night than day; the opposite was found for the period when sockeye dominated.

**Technical Review:** Results are technically reviewed by Pacific Northwest Fish and Wildlife agencies and by staff scientists at the Water Budget Center.

**Evaluation of Effectiveness :** Effectiveness is determined by whether or not the index adequately represents run timing. To date, surges in the index correspond to releases of hatchery fish.

**Degree of Program Measure Fulfillment:** This in-season smolt monitoring project is completed. Other studies will address remaining aspects of the program measure.

## **SESSION II**

### **NATURAL PROPAGATION AND HABITAT IMPROVEMENT**

**LAKE BRANCH CHANNEL REHABILITATION  
AND HABITAT IMPROVEMENT**

**David A. Heller, Project Leader  
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BPA Project Officer: Larry Everson  
BPA Project Number: 84-11  
Program Measure Number: 704 (d)(l)**

**Relationship to Program Measure:** This project is being conducted under Program Measure 704 (d) (1), Habitat Improvement and Passage Restoration.

Lake Branch of the West Fork Hood River is an important producer of summer steelhead trout. Habitat for spring chinook exists throughout Lake Branch, and spring chinook are being introduced through a STEP hatch box project. Anadromous fish habitat is generally good but is locally limited by marginal spawning habitat, low flow rearing habitat, and possibly by a scarcity of overwintering habitat.

The 1984 project represents the second phase of a planned five-year anadromous fish enhancement program in the West Fork Hood River Drainage. The project area was obtained by the Mt. Hood National Forest from Hood River County through a land exchange in 1981. Past management activities removed most of the overstory vegetation and instream woody structure, resulting in an unstable channel with little spawning habitat and poor-quality rearing habitat in the project reach. The objectives of this project are to increase low flow rearing habitat, provide spawning habitat, and test a variety of prototype structures.

**Technical Results:** Eleven structures were placed in the main channel of Lake Branch, and 12 structures were placed in an excavated side channel. The structures, made of large timbers and boulders, provide hydraulic controls that concentrate flow to create scour or form drops to create plunge pools. The excavated side channel will provide spawning and year around rearing habitat.

**Technical Review :** This project has been subjected to annual pre-project design reviews, periodic field reviews, and annual post-project critiques held with all project participants.

**Evaluation of Effectiveness :** Because of the relatively high gradient, high energy nature of Lake Branch Creek, implementation of instream habitat improvement projects will proceed cautiously. Project effectiveness will be evaluated in two stages. In the first three years, we will:

1. apply prototype projects on representative problem sites
2. evaluate the costs and success of those projects (success measured by changes in habitat type, quantity, quality, and habitat use)

3. accomplish detailed planning and coordination with ODFW and CTWS to identify future sites and project priorities.

With the results of these efforts in hand, we will use the last two years of the program to concentrate on:

1. maximum implementation of projects to meet the priority needs
2. modification of existing projects, as needed
3. continuation of project evaluations.

**Degree of Program Measure Fulfillment:** The 1984 Lake Branch project is the second phase of a planned five-year, basin-wide enhancement program within the West Fork Hood River Drainage. Work in the next fiscal year will include excavation of two side channels, boulder placement, berm construction, and development of an enhancement plant for the West Fork drainage.

**CLACKAMAS/HOOD RIVER HABITAT ENHANCEMENT  
PROJECT III: FISH CREEK/WASH CREEK  
HABITAT IMPROVEMENT**

**Dave Heller, Project Leader  
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BPA Project Officer: Larry Everson  
BPA Project Number: 84-11  
Program Measure Number: 704 (d)(I)**

**Relationship to Program Measure :** The Fish Creek/Wash Creek habitat improvement project [Program Measure 704 (d)(I) ] is improving spawning and rearing habitat for chinook and coho salmon and steelhead trout in a tributary to the Clackamas River. The program is jointly funded by the Forest Service and BPA.

**Fish Creek, a fifth order stream, is one of the major producers of salmon and steelhead in the upper Clackamas River system. An absence of large structure is thought to be responsible for a scarcity of quality spawning, rearing, and overwintering habitat. As a result, habitat capability and smolt production are substantially below potential for all anadromous species.**

**Technical Results :** In 1983, the second year of this project, we excavated 700-foot-long side channel to increase rearing and overwintering habitat. Twelve trees were felled into Fish Creek to increase large woody debris in reaches of boulder riffle. Four acres of streamside, equating to one linear mile of stream, were planted with cottonwood seedlings to restore stream shading. Biological surveys of tributaries and mainstem winter habitat plus engineering surveys of project sites were conducted to facilitate future

**project planning implementation and monitoring. Maintenance of 1983 project work was also completed. Finally, the Fish Creek Evaluation completed its third year of data collection on *the* Fish Creek system, incorporating 1984 project sites into the work schedule.**

**Technical Review :** Proposed projects are reviewed by biologists of the Oregon Department of Fish and Wildlife. Independent consultants who are recognized experts in their fields have been employed to assist in the design of instream structures.

**Evaluation of Effectiveness :** Improvement projects in the Fish Creek drainage are evaluated in the Fish Creek Evaluation, a multi-year project funded by the Forest Service and the BPA. The 1984 annual report of their activities was given in a separate presentation.

**Degree of Program Measure Fulfillment:** This was the third year of the multi-year Fish Creek Habitat Improvement Program. Since Fish Creek represents only a small portion of the Columbia River Basin, a significant portion of Program Measure 704 (d)(1) will remain to be completed at the conclusion of the Fish Creek project.

#### **HOOD RIVER FISH PASSAGE**

**Jim Newton, Project Leader  
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BPA Project Officer: Dale Johnson  
BPA Project Number: 83-341  
Program Measure Number: 704 (e)(1)**

**Relationship to Program Measure:** Access to much of the 23 miles of available anadromous fish habitat on the West Fork Hood River and its major tributary, Lake Branch Creek, is currently blocked by a 15-foot-high falls on the West Fork Hood River at river mile 3.0. Construction of a long-term passage facility at this falls meets with the intent of Program Measure 704 (e) (1) and will expand the habitat suitable for use by spring and fall chinook, coho, and winter and summer steelhead.

**Technical Results :** Geotechnical investigations by Rittenhouse- Zeman Associates and topographic mapping of the falls area by Chickering Green Empire, Inc. have been completed. Two schemes to provide fish passage and falls stabilization have been developed. Cost estimates for the schemes range from \$420,000 to \$680,000.

**Technical Review :** Preliminary stabilization passage designs were reviewed by BPA and the Oregon Department of Fish and Wildlife. Approval of final design is pending..

**Evaluation of Effectiveness :** Present plans do not call for an evaluation of the effectiveness of the passage facility, because costs of establishing a monitoring facility at the site are prohibitive. Construction of a monitoring facility lower in the Hood River system should be implemented in the future to allow us to evaluate this and other projects throughout the drainage. It is estimated that completion of the project will allow 2000 adult summer steelhead to fully seed the West Fork Hood River system.

**Degree of Program Measure Fulfillment:** Completion of technical investigations and topographic mapping enables the Oregon Department of Fish and Wildlife to complete Task I (Preliminary Design) of the proposed work.

#### **WHITE RIVER FALLS PASSAGE: FISHERIES PHASE**

**Robert B. Lindsay and R. Kirk Schroeder, Project Leaders  
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BPA Project Officer: Larry Everson  
BPA Project Number: 83-440b  
Program Measure Number: 704 (d)(1)**

**Relationship to Program Measure :** Biological and physical characteristics of White River drainage, a tributary of the Deschutes River in Oregon, were studied in 1983 and 1984 to determine the feasibility of introducing anadromous salmonids into the watershed. Access to White River by anadromous fish is blocked by waterfalls located 3.4 km from the confluence with the Deschutes River. The need for a feasibility study of passage restoration in the White River is identified in Section 704 (d)(1) of the Columbia River Basin Fish and Wildlife Program (1982).

The White River Study was a coordinated effort among Oregon Department of Fish and Wildlife (ODFW), Mt. Hood National Forest, and Ott Water Engineers. ODFW studies focused on juvenile passage, estimates of potential production, species and stocks best suited for introduction, and potential impacts of anadromous introduction on resident fish.

**Technical Results :** Survival of juvenile steelhead in a free fall of 43 m at White River Falls was 160% during high flows (300 to 600 cfs) in 1983 and 1984. Survival of juvenile chinook averaged 90% at high flows and 72% during low flows (100 to 300 cfs) in 1983 and 1984.

Eighteen irrigation ditches in the watershed would require screens to protect downstream migrants. The screens would cost \$58,000 to construct and could be operated and maintained at an annual cost of \$14,500. Potential production of steelhead in the White River system was estimated at 1500 to 2500 adults, and potential production of chinook was estimated at 1000 to 1500 adults. The greatest opportunity for increasing salmon and

steelhead production would be to provide passage for adults at irrigation diversion dams. Deschutes River stocks of spring chinook and summer steelhead are best for introduction and would most fully utilize the habitat in White River basin.

Spawning areas for spring chinook in White River are reduced by the deposition of glacial silt in the upper mainstem in September, the peak month of spawning for spring chinook. High sediment and turbidity levels in White River did not appear to affect the condition of resident fish or their ability to feed.

Rainbow trout, brook trout, mountain whitefish, several species of sculpins, longnose dace, and largemouth bass were the only resident species of fish found in White River above the falls. Rainbow trout composed 45% of the number and 73% of the biomass of resident fish above the falls. Sculpins composed 48% of the number of fish in the watershed and 17% of the biomass. The genetic structure of rainbow trout from White River is significantly different from rainbow and steelhead trout in the Deschutes River. No viruses were detected in fish from White River examined in 1983 and 1984. Bacterial kidney disease was found in rainbow and brook trout from the upper watershed in 1983. Results of two experiments indicated that Ceratomyxa Shasta is not present in White River basin.

**Technical Review:** A draft report of the study has been reviewed by a biologist from Oregon State University, the U. S. Forest Service, and the Confederated Tribes of the Warm Springs Indian Reservation.

**Evaluation of Effectiveness:** The feasibility study addressed all objectives identified in the work plan for 1983 and 1984 (Phase I). Ultimately, the effectiveness of Phase II of this project will be determined by the development of a self-sustaining run of anadromous fish.

**Degree of Program Measure Fulfillment:** After Phase I is completed, the project results will be subjected to public review and then submitted to the Oregon Fish and Wildlife Commission for approval. Fish will be introduced to White River pending the Commission's approval.

## **WHITE RIVER FALLS FISH PASSAGE**

**Ron Ott, Project Leader  
Ott Water Engineers, Inc.  
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BPA Project Officer: Larry Everson  
BPA Project Number: 83-450  
Program Measure Number: 704 (d)**

**Relationship to Program Measure:** The White River Falls Project is part of Program Measure 704 (d). The project will provide passage for salmon and steelhead over a 180-foot-high natural falls and will open over 100 miles of new spawning and rearing habitat in north central Oregon.

**Technical Results :** A number of alternative methods to provide adult passage over White River Falls have been investigated in this study. Four alternatives that would provide cost-effective and reliable passage were identified during fiscal years 1983 and 1984. These included two trap and haul alternatives, and two fishway alternatives. Of those four alternatives, a trap and haul alternative has been identified as the "preferred solution." Results of the study will be reported to BPA in April 1985.

**Technical Review:** Preliminary designs of passage facilities at White River Falls have been reviewed by the Oregon Department of Fish and Wildlife. The final decision on a preferred alternative was made in conjunction with the Oregon Department of Fish and Wildlife.

**Evaluation of Effectiveness:** The effectiveness of the White River Falls Project can readily be measured. If the project is effective, thousands of adults will return to a watershed that has never supported anadromous fish. If the project is ineffective, few, if any, fish will return to the watershed.

**Degree of Program Measure Fulfillment:** Measure 704 (d) contains many projects, one of which is White River Falls. Ott Water Engineers, Inc. is preparing preliminary and final designs of passage facilities at White River Falls and is also working to ensure NEPA compliance. The Oregon Department of Fish and Wildlife and Mt. Hood National Forest are performing habitat, disease, resident fish, and downstream migration analyses. The White River Falls portion of Measure 704 (d) will be complete when the passage facilities have been constructed and the fish runs have been established.

## **STUDY OF WILD SPRING CHINOOK IN THE JOHN DAY RIVER**

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BPA Project Officer: Larry Everson  
BPA Project Number: 79-4  
Program Measure Number: 704 (a)**

**Relationship to Program Measure :** The Oregon Department of Fish and Wildlife began a study of harvest, migration, and life history of wild spring chinook salmon in the John Day River in the 1978. The project, begun before the Fish and Wildlife Plan was adopted, provides data for Program Measure 704 (a). The study provides information that can be used to recommend harvest regulations for achieving escapement goals, to recommend the time of year when passage measures should be used at Columbia River dams to increase survival of John Day River migrants, and to recommend habitat or environmental improvements that will increase spring chinook production. Data from the project would also be used to define the escapement that produces the largest harvestable surplus of adults, and to recommend operational procedures for hatchery supplementation in the John Day River in the event that it becomes necessary to artificially maintain the run.

**Technical Results :** Coded-wire tagged spring chinook from the John Day River were recovered in lower Columbia River test and tribal ceremonial fisheries during April and May from 1981 through 1984. We recommend that commercial and sport salmon seasons in the Columbia River be closed from mid-March through May to prevent overharvest of John Day River stocks.

**Marked smolts from the John Day River have been recovered in the Columbia River during the months of April through June from 1979 to 1984. Measures to enhance passage. of juvenile chinook in the Columbia River should be done during April through June to provide the most benefit to smolts from the John Day River.**

**John Day River spring chinook spawn during September, and fry emerge from late February through June. Major spawning areas are located in the mainstem above Prairie City, in the Middle Fork above Armstrong Creek, in the North Fork above Camas Creek, and in the Granite Creek system. Most adults return to spawn at age 4 and virtually all smolts migrate at age 1+.**

**Analysis of stock-recruitment relationships (developed from spawning surveys in "index areas" since 1959) revealed a shift in spawner-recruit relationships beginning with the 1970 brood. John Day River stocks have generally been below the replacement level, and escapements have been declining since the 1970 brood. The change in spawner-recruit relationships has been from density-dependent relationships for the pre-1970 broods to density-independent relationships for the 1970 to 1979 broods. We believe that these shifts have resulted from increased mortality during**

**passage through the Columbia River since the completion of John Day Dam. Increased passage mortality has reduced escapements so that in-stream habitats are no longer seeded to capacity.**

**Current trends in the North Fork System indicate that the stock will be extinct in 20 to 30 years (or sooner) unless survival rates increase or the run is supplemented with hatchery fish. However, if the run is to be supplemented with hatchery fish spawned from native stock, we may want to consider collecting adults and developing a brood stock much sooner. Improvements in in-stream habitats are not likely to increase production in the John Day River system unless they are accompanied by increases in out-system survival.**

**Technical Review: The results of this project will be technically reviewed by BPA staff. Results are also reviewed by other scientists during annual BPA project presentations.**

**Evaluation of Effectiveness: Results, conclusions, and recommendations of this project will be made available in a published report. Use and implementation of those recommendations is beyond the control of this project but could be construed, ultimately, as one measure of project effectiveness.**

**Degree of Program Measure Fulfillment: This study of wild spring chinook in the John Day River is scheduled for completion in December 1985. We are currently preparing a comprehensive final report of our results and recommendations.**

#### **NORTH FORK JOHN DAY RIVER HABITAT IMPROVEMENT**

**John Andrews , Project Leader  
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BPA Project Officer: Larry Everson  
BPA Project Number: 84-8  
Program Measure Number 704 (d)(l)**

**Relationship to Program Measure: This project, which responds to Program Measure 704 (d) (1) Table 2, will improve off-site anadromous fish habitat on streams in the North Fork John Day Basin.**

**Technical Results : Personnel from the Umatilla National Forest completed all construction work planned for 1984. This work consisted of opening three side channels, constructing ten log and rock weirs to increase rearing pool habitat, placing three rock deflectors at side channel entrances for flow control; constructing four rock deflectors to direct flow in side channels, and placing 250 large boulders in side channels and in the main river to provide instream cover.**

**During July and August 1984, the Forest staff placed riprap at one site and installed 17 rock deflectors to protect unstable streambanks in Granite Creek. Previously constructed structures in Clear Creek were protected by placing riprap at 70 sites. The Forest staff also placed 700 cubic yards of spawning gravel at 14 sites in Clear Creek to provide increased anadromous fish spawning opportunities and constructed seven rock weirs, installed 74 large boulders, and planted 800 hardwood clumps and cuttings to provide shade and improve juvenile anadromous fish rearing habitat.**

**An environmental assessment of anadromous fish habitat improvement within the North Fork of the John Day Sub-basin has been prepared. This report was prepared with interdisciplinary input from soils, watershed, and wildlife specialists and with participation by Confederated Tribes of the Umatilla Indian Reservation and Oregon Department of Fish and Wildlife.**

**A detailed stream survey of anadromous fish habitat covering 13.5 miles of stream in the Umatilla Basin was completed. The Forest's Umatilla River Basin Fish Habitat Improvement Environmental Assessment will be completed during the spring of 1985.**

**Evaluation of Effectiveness : Effectiveness will be determined by how well the project reduces the factors that limit fish production. It is anticipated that the project will provide an increase in production of up to 11,900 spring chinook smolts in the North Fork John Day Basin. Monitoring of the project results has been coordinated with the Oregon Department of Fish and Wildlife.**

**Degree of Program Measure Fulfillment: The North Fork John Day Side Channel portion of the project is approximately 50% complete. Activities planned for the 1985 field season should complete another 25% of the project. The Granite and Clear creeks portions of the project are essentially complete.**

#### **BPA UPPER GRANDE RONDE 1984 PROJECT ACCOMPLISHMENTS**

**Rod Miller, Project Leader  
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BPA Project Officer: Larry Everson  
BPA Project Number: 84-9  
Program Measure Number: 700 (d)**

**Relationship to Program Measure: This habitat improvement project in the Wallowa-Whitman National Forest addresses Program Measure 700 (d) of the Fish and Wildlife Program. It is recognized that systems within the Grande Ronde river basin have not reached their full habitat potential. Specific problems include inadequate pool riffle structure and riparian degradation.**

**Technical Results :** Forty structures were installed in Elk Creek to create an estimated 1000 additional square feet of pool area and improve overall pool quality. Two miles of stream planting and 3.4 miles of stream fencing were completed in Peavine Creek. Treated areas are expected to respond with lowered water temperatures, improved streambank condition, and elevated late season flows of water.

Systematic stream inventories were made in the Upper Grande Ronde River and in Sheep Creek to evaluate the specific needs for improvement measures. Priorities were established within each reach based on the expected improvement benefits, and sites were located and staked in preparation for implementation. Permanent monitoring stations were placed in Sheep Creek for pre-improvement evaluation of existing habitat conditions. The same is planned for the Upper Grande Ronde River. Three reaches in Sheep Creek were sampled by electrofishing methods to establish population baselines. Sampling will be replicated one year after installation and thereafter every five years for at least a 10-year period.

Structures planned for Sheep Creek range from sealed log sills to winged digger logs to boulders. Over 5500 square feet of additional pool areas could be provided by these 156 structures. It may also be possible to raise the average pool quality in each reach by one index number (see Forest Service publication INT-138). Also 10,880 linear feet of stream edge are targeted for planting in the spring of 1986, roughly 33% of the potential stream edge that could be planted in the project area. This activity is expected to reduce significantly water temperatures at the downstream monitoring station throughout the life of the project.

**Technical Review:** Technical guidance in the areas of inventory and monitoring was obtained from Forest Service publication INT-138, "Methods for Evaluating Stream, Riparian, and Biotic Conditions." Guidance was also provided through a letter from the Region IV-Northeast Oregon Office, Oregon Department of Fish and Wildlife, which listed eight objectives for habitat improvement for the Upper Grande Ronde system. Design developments were structured from the latest technical developments reported in the Northwest.

**Evaluation of Effectiveness :** Effectiveness will eventually be determined by the increase in the number of fish that use the selected sites.

**Degree of Program Measure Fulfillment:** The Upper Grande Ronde project is about 20% complete. What remains is to construct the structure and complete the plantings and post-project monitoring. The projects on Peavine and Elk creeks are about 85% complete. Fence building, two miles of plantings, and post-monitoring remain to be completed.

**HABITAT QUALITY AND ANADROMOUS FISH PRODUCTION  
POTENTIAL ON THE WARM SPRINGS INDIAN RESERVATION**

**Cris Stainbrook, Project Leader**

**The Confederated Tribes of the Warm Springs Indian Reservation of Oregon  
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**BPA Project Officer: Tom Vogel**

**BPA Project Number: 815-8**

**Program Measure Number: 704 (d)**

**Relationship to Program Measure :** This project on the Warm Springs Indian Reservation of north central Oregon encompasses two aspects of Program Measure 704 (d) . The project will identify habitat and passage problems within reservation streams and propose corrective measures and habitat enhancement projects. Second, the project will establish baseline information on the anadromous fisheries resource of reservation streams to evaluate the completed projects and identify production goals for the Deschutes River system.

**Technical Results :** Preliminary results of this project will be published in early summer. Stream surveys to date indicate the Warm Springs River system is underseeded compared to other area streams. The surveys also indicate that over-wintering habitat is probably the factor limiting spring chinook production in reservation streams.

**Two habitat projects have been identified.** In 1984, a bypass channel was constructed around a passage barrier at Strawberry Falls. This bypass will allow the upstream migration of salmon and steelhead into an area of approximately seven miles of good to excellent spawning and rearing habitat. The second project, now in the planning stage, involves instream corrective measures in the stretch of Beaver Creek that was channelized during construction of Highway 26.

**Technical Review:** Project plans were initially reviewed by the BPA Project Officer and by other tribal staff. Specific enhancement or corrective actions are reviewed by the BPA Project' Officer, the tribal Watermaster, and by tribal biological staff and committees. Informal review and input was solicited from the Oregon Department of Fish and Wildlife, Oregon State University, Columbia River Inter-Tribal Fish Commission, and the biological staffs of other tribes.

**Evaluation of Effectiveness :** Project effectiveness will be determined by increases in redd counts, out-migrant production, and expanded habitat utilization.

**Degree of Program Measure Fulfillment:** The stream surveys in Warm Springs River system will continue through 1992. Studies in other parts of the Deschutes River system are also providing data needed to address this program measure.

**A PLANNING AID FOR THE REHABILITATION OF ANADROMOUS  
FISH STOCKS IN THE UMATILLA RIVER BASIN, OREGON**

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BPA Project Officer: Tom Vogel  
BPA Project Number: 84-10  
Program Measure Numbers: 704 (d)(1) and 704 (i)(1)**

**Relationship to Program Measure:** The Umatilla Comprehensive Rehabilitation Plan addresses Program measures 704 (d) (1) and (i) (1). The Plan, in draft form, has three primary objectives:

- 1. Determine fishery rehabilitation objectives for naturally and hatchery produced salmonids.**
- 2. Determine natural and hatchery production fishery benefits from proposed flow enhancement and fishery rehabilitation projects.**
- 3. Develop a plan to rank, implement, and evaluate the projects to achieve the rehabilitation objectives.**

**The Plan is being developed by the Oregon Department of Fish and Wildlife in cooperation with the Confederated Tribes of the Umatilla Indian Reservation, the National Marine Fisheries Service, the Fish and Wildlife Service, the Bureau of Reclamation, and the Forest Service.**

**The rehabilitation plan allows the rehabilitation projects to be ranked and provides schedules for implementation and evaluation. Upstream and downstream passage improvements would provide greatest benefits to fall chinook, whereas habitat improvements would yield greatest benefits to summer steelhead and spring chinook. Natural and hatchery production rehabilitation objectives established for the Basin are 7,500 summer steelhead, 21,000 fall chinook, and 10,500 spring chinook.**

**Technical Results:** Flow enhancement projects that have been evaluated in this project include the Bureau of Reclamation's Columbia River Pumping and Meacham Dam Plans [704 (d)(2)] and the McKay Storage Plan. Fishery rehabilitation projects that have been evaluated include upstream and downstream passage improvements at diversion dams and canals and in the lower channel- [704 (d)(1)] ; habitat improvements in important headwater streams [704 (d) (1) ] ; and hatchery supplementation/reintroduction projects including fall chinook reintroduction and broodstock development, adult collection/ juvenile release facilities, and a hatchery for 200,000 summer steelhead [704 (i) (1) ]

**The Bonifer adult collection and juvenile release facility was constructed in 1983. Final designs for the Minthorn facility was completed in 1984. Major**

work was completed in 1984 on lower channel modification. Site investigations were completed in early 1985 for the Umatilla River Summer Steelhead Hatchery.

**Technical Review :** The final draft of the Rehabilitation Plan will be available on July 1, 1985. BPA will submit the plan to appropriate agencies for technical review and comment.

**Evaluation of Effectiveness:** Simple life history models were used to determine benefits of the rehabilitation projects to natural and hatchery production. Under each of the flows, accomplishment of all rehabilitation projects would provide substantial fishery benefits in the basin. For example, the number of naturally and hatchery produced adult summer steelhead and fall and spring chinook could be increased from 26,240 adults under existing flows to 45,144 to 49,657 adults under flows provided by the Bureau's flow enhancement projects. Under flows of the McKay Storage Plan, production would increase to 28,744 adults.

**Degree of Program Measure Fulfillment:** Completion of the draft plan will be a major milestone of this project. Acceptance and implementation of the plan will fulfill the program measure.

**MINTHORN SPRINGS CREEK SUMMER STEELHEAD JUVENILE  
RELEASE AND ADULT COLLECTION FACILITY**

**Gary James, Project Leader  
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P.O. Box 638 Pendleton, Oregon 97801, (503) 276-8221  
BPA Project Officer: Tom Vogel  
BPA Project Number: 83-435  
Program Measure Number: 704 (i) (1)**

**Relationship to Program Measure :** The Minthorn Springs juvenile release and adult collection facility, part of Program Measure 704 (i)(1), is located on the Umatilla Indian Reservation. The facility is a critical element in the Umatilla Basin salmon and steelhead restoration program. The Minthorn facility will consist of a concrete fishway and two juvenile raceways near the mouth of Minthorn Springs Creek.

The facility will be used for acclimation of juvenile- salmon and steelhead and for holding of adults before spawning. Adult steelhead that return to Minthorn Springs Creek or eggs from those fish will be outplanted in underseeded natural production areas throughout the Umatilla drainage. Some returning adults (adipose fin clipped) may be used for brood stock, but wild fish will be the main broodstock component to maintain genetic integrity.

**The Minthorn facility will also be used for restoration of chinook salmon runs to the Umatilla Basin. Upriver bright fall chinook juveniles from Bonneville Hatchery will be released annually for development of hatchery and naturally producing runs.**

**The Unatilla Hatchery, also part of Program Measure 701 (i)(1)-, is now in the preliminary design phase and will be the "mother" hatchery for both the Minthorn and Bonifer facilities.**

**Technical Results : Project engineer inspectioins will be a part of the opening construction phase.**

**Evaluation of Effectiveness: Eventually all or a portion of the juvenile fish released at the facility will be marked so returns can be monitored for evaluation of facility effectiveness.**

**Degree of Program Measure Fulfillment: Projects under Program Measure 701 (i) (1) include the Bonifer and Minthorn Acclimation facilities on the Umatilla Reservation and the Umatilla Hatchery to be located near Irrigon, Oregon. After the Minthorn Springs project is completed in 1985, remaining projects will include the construction of the Umatilla Hatchery for annual production of 200,000 steelhead smolts and the operation and maintenance of the Bonifer and Minthorn Facilities.**

**OPERATION AND MAINTENANCE OF THE BONIFER  
SPRINGS JUVENILE ACCLIMATION AND ADULT  
HOLDING FACILITY**

**Gary James, Project Leader  
Confederated Tribes of the Umatilla Indian Reservation  
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BPA Project Officer: Tom Vogel  
BPA Project Number: 82-18  
Program Measure Number: 704 (i) (1)**

**Relationship to Program Measure: The Bonifer Springs juvenile release and adult holding facility, part of Program Measure 707 (i) (1), is located on the Umatilla Indian Reservation. The facility is an important element in the Umatilla Basin anadromous fish restoration program. The Bonifer facility consists of a fishway at the outlet of a one-acre spring-fed pond. The facility will be used for acclimation of juvenile salmon and steelhead and for holding of adults before spawning. Adult steelhead returning to Bonifer or eggs from those fish will be outplanted in underseeded areas throughout the Umatilla drainage. Some returning fish (adipose fin clipped) may be used for hatchery broodstock, but wild fish will be the main broodstock component to maintain genetic integrity.**

**The Bonifer facility will also be used to restore chinook salmon in the Umatilla Basin. Upriver bright fall chinook juveniles from the Bonneville Hatchery will be released from Bonifer annually to develop hatchery and naturally producing runs.**

**The Umatilla Hatchery, also part of Program Measure 701 (i) (1) , is now in the preliminary design phase and will be the "mother" hatchery for both the Bonifer and Minthorn facilities.**

**Technical Results: The Bonifer Facility was completed in 1983. In early 1984, 52 adult summer steelhead were captured in the lower Umatilla River and were held- at Bonifer prior to spawning. Approximately 100,000 eggs were taken from 21 females in April and May. The eggs were transported to Oak Springs Hatchery for incubation and juvenile rearing. Yearlings will be released into Bonifer Pond in the spring of 1985.**

**In mid-March 1984, 70,000 yearling upriver bright fall chinook were acclimated in Bonifer Pond for two weeks prior to release, as were 60,000 yearling summer steelhead in early May.**

**Technical Review : Not applicable; the facility is operational.**

**Evaluation of Effectiveness : Returns resulting from annual steelhead releases (50,000-60,000) from Bonifer Pond are expected to double the present adult run of 1000 fish within three years. Decreased mortality was observed in 1984 compared with years prior to construction of the Bonifer facility. Adult steelhead holding mortality at Bonifer was only 7% in 1984 as compared to 33% in 1983 when fish were kept in a holding tank at McNary Dam. Juvenile salmon and steelhead mortality following release into the pond was negligible compared to observed mortality following instream releases in previous years.**

**Degree of Program Measure Fulfillment: Projects remaining for completion of Program Measure 704 (i) (1) include construction of the Umatilla Hatchery for annual production of 200,000 steelhead smolts (to be released at both acclimation facilities), and operation and maintenance for both acclimation facilities.**

YAKIMA RIVER SPRING CHINOOK ENHANCEMENT STUDY

**Larry Wasserman, Project Leader**  
**Yakima Indian Nation, Fisheries Resource Management**  
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**BPA Project Officer: Tom Vogel**  
**BPA Project Number: 82-16**  
**Project Measure Number: 704 (k)(l)**

**Relationship to Program Measure: The Yakima Indian Nation was contracted by BPA in 1982 to evaluate hatchery supplementation techniques that can be used to increase runs of naturally produced spring chinook in the Yakima River. Although this project was initiated before adoption of the Fish and Wildlife Program, it addresses Program Measure 704 (k) (l) , which is concerned with the best methods of introducing hatchery fish to rebuild naturally spawning stocks.**

**The Yakima Nation has an enhancement policy of maintaining, as much as possible, the genetic integrity of the spring chinook stocks native to the Yakima River basin. By determining the life history of these stocks, resource managers can minimize the negative interactions between wild and hatchery fish. The information can also be used to determine the relative effectiveness of different methods of hatchery supplementation.**

**Technical Results : All spring chinook released were tagged with coded wires. Some fish were cold branded as well. Freshwater survival of each release group was determined by use of a downstream migrant trap, and returning adults were counted at Roza and Prosser dams. In addition, extensive spawning ground surveys were made and tags were recovered from carcasses and fisheries. Six groups of hatchery fish will be tested: smolts trucked from Leavenworth N. F.H. and released directly to the river; fish reared in earthen ponds for six months and volitionally released as smolts ; smolts released from acclimation ponds ; fingerlings released in June, September, and November; wild brood stocks; and wild/hatchery hybrid brood stocks. Releases began in 1983 and adult returns are expected in 1985.**

**Monthly beach seining showed a general downstream movement of fish soon after emergence. The greatest number of fish were captured near RM 135; few fish were captured below RM 118. during the summer when temperatures were high. Fish were distributed throughout the system during the winter. Survival to emergence tests showed mean survival equal to 20; 6%, with mean emergence date extending from April 9 to May 13 in 1984. Smolt yield for 1984 was estimated to be 178,230, and counts from the migrant trap were reported daily to the Water Budget Center. Adult returns in 1984 totaled 2677.**

**Freshwater survival rates for spring chinook released from earthen ponds, and those released to the river directly after trucking, were 66.4% and 42.8%, respectively. It was estimated that 32 .6% of the fish released in**

**June had migrated 125 miles downstream by July. Run timing to Roza Dam of hatchery fish released in 1982 was 13 days earlier than for wild fish. From a 1982 release of fish trucked directly to the river as smolts, 274 four-year-old adults returned to the Yakima River, yielding a return rate of 0.068%. Fish reared and released from earthen ponds contributed 194 adults and returned at a rate of 0.19%.**

**Technical Review :** The study design has been reviewed by the Columbia River Intertribal Fish Commission and the U. S . Fish and Wildlife Service. A private consultant, Douglas Chapman, has also reviewed portions of the study design.

**Evaluation of Effectiveness:** Effectiveness of this project will be determined by freshwater survival, adult returns, and adult timing. Since the project is not scheduled for completion until 1991, no immediate evaluation of effectiveness can be made.

**Degree of Program Measure Fulfillment:** Other studies addressing Program Measure 704 (k) (1) are in progress. The project will provide information necessary to make management decisions regarding hatchery supplementation techniques.

**LOW TECHNOLOGY FISHERIES FACILITIES FOR THE  
THE ENHANCEMENT OF ANADROMOUS SALMONID  
STOCKS ON THE NEZ PERCE RESERVATION**

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Nez Perce Tribe  
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BPA Project Officer: Tom Vogel  
BPA Project No: 83-350  
Program Measure: 704 (j)(2)**

**Relationship to Program Measure:** Program measure 704 (j) (2) calls for the construction of low capital propagation facilities on the Nez Perce Reservation. The Nez Perce Tribe is in the process of selecting sites, developing preliminary designs, and formulating a hatchery management plan for potential anadromous fish production facilities that could be constructed in the Clearwater Basin. The output from this work is designed to interface with Program Measures 704 (d) (1) and 704 (e) (1), to provide an integral enhancement action to help restore upriver stocks of salmon and steelhead.

**Technical Results:** Site selection was coordinated with state, federal, private, and tribal agencies. The field was narrowed down to one main water source and three facility alternatives. Preliminary design, capital, and operation and maintenance cost estimates were made, and a management strategy was developed for each alternative. The tribe has identified a

**plan which incorporates a spring water collection site--a pipeline to the hatchery facility at Spaulding , Idaho, which provides both an incubation and early rearing water supply and power to the facility--as the best alternative to meet the enhancement needs.**

**Technical Review:** The facility development program is now entering the NEPA requirement stage.

**Evaluation of Effectiveness:** Effectiveness of the project will not be determined until data on the impacts of operation are available for analysis.

**Degree of Program Measure Fulfillment:** This contract addressed the preliminary aspects of facility design. After the final design is completed, construction of the facility can begin. This facility is an important component of a large-scale enhancement scheme for the Clearwater Basin.

**A BIOLOGICAL AND PHYSICAL INVENTORY OF THE  
STREAMS WITHIN THE NEZ PERCE RESERVATION**

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BPA Project Officer: Tom Vogel  
BPA Project Number: 82-1  
Program Measure Number: 704 (e) (1)**

**Relationship to Program Measure:** This stream inventory project was initiated before the Fish and Wildlife Program was adopted. The intent of the inventory was to collect biological and hydrological information needed to assess the stream and habitat conditions such that recommendations for improving the anadromous fish resources could be made. Although not directly related to a program measure, the inventory study objectives have been modified to more closely align with program measure 704 (e)(1). The current study was divided into a stream inventory and juvenile steelhead study.

**Technical Results: Stream Inventory.** This was the final year of a three-year inventory on the streams of the lower Clearwater Basin within the Nez Perce Reservation. The present inventory focused on Clear Creek, Orofino Creek, and the Potlatch River. The recommended enhancement measures were to revegetate the lower and headwater areas of Clear Creek, to improve passage into Orofino Creek, and to provide flow augmentation in the Potlatch River.

**Juvenile Steelhead Study.** Subyearling and overyearling rainbow steelhead trout and supporting habitat were sampled monthly to determine population fluctuations under various habitat conditions. Densities of subyearling steelhead declined from high initial densities in June to lower and more

**uniform ranges in November prior to the fall outmigration and overwintering period. Overyearling steelhead densities showed a general decline from spring through fall prior to overwintering. Lack of overyearling habitat appeared to constrain their relative abundance. Daily downstream migrant trapping indicated a smaller fall pulse in movement and a more prominent spring outmigration. Large numbers of pre-smolt fish move out of the streams and presumably rear in the Clearwater or Snake rivers.**

**Technical Review: Technical review of the stream inventory has been conducted by the Nez Perce Tribe Fisheries Department and also will be undertaken by the BPA. The draft final report of the juvenile steelhead study has yet to be prepared.**

**Evaluation of Effectiveness: Information gained in the stream inventory will aid in identifying those basins where enhancement and restoration methods are needed. Ranking of streams for potential enhancement and proposed project implementation can then proceed.**

**Degree of Program Measure Fulfillment: Not applicable because this project was initiated prior to adoption of the Fish and Wildlife Program.**

#### **ALTURAS LAKE CREEK FLOW AUGMENTATION**

**Harvey L. Forsgren II, Project Leader  
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BPA Project Number: 83-415  
Program Measure Number: 704 (d)(I)**

**Relationship to Program Measure: The Alturas Lake Creek (ALC) flow augmentation project is part of Program Measure 704 (d)(I) and represents one of the finest “habitat improvement and passage restoration” opportunities for off-site mitigation in Idaho. Augmentation of streamflows in ALC, depleted by irrigation withdrawal, will provide for improvement of chinook salmon rearing habitat and for restoration of chinook and sockeye salmon passage into the 80% of the ALC drainage that is currently inaccessible.**

**Technical Results: Two approaches to resolve the conflict between irrigation use and fishery needs are being evaluated. The first approach involves construction of an outlet control structure on Alturas Lake to store spring runoff for release into ALC in late summer and early fall; The runoff would accommodate upstream migrating and spawning salmon. The second approach is to acquire all or part of the water rights held on ALC for instream use by the fish. Both alternatives are deemed technically feasible. Selection of a preferred alternative will be based upon several factors, such as implementation cost, time frame within which the alternative**

could be implemented, environmental impacts, and resulting benefits. At full escapement, it is estimated that the lake storage alternative would result in an increase of production capability of up to 210,000 chinook and 950,000 sockeye smolt. Increase in production capability resulting from acquisition of a minimum passage flow is estimated at up to 155,000 chinook and 950,000 sockeye smolt.

**Technical Review:** Not applicable.

**Evaluation of Effectiveness:** In 1984, under BPA contract, the Idaho Department of Fish and Game (IDFG) initiated a project to evaluate the effectiveness of Northwest Power Planning Council Fish and Wildlife Program projects implemented in Idaho. In the ALC drainage, permanent stations to determine juvenile salmon standing crop (numbers per 100 m<sup>2</sup>) were established within stream reaches upstream and downstream of the irrigation diversion structure. In 1985, IDFG hopes to establish up- and downstream migrant traps on ALC to monitor spawning escapement and resulting juvenile production. These escapement and production data will document pre- and post-project implementation conditions and provide for a thorough evaluation of the effectiveness of the ALC flow augmentation project. These escapement and production data should also prove valuable in evaluating the potential benefits resulting from other fish habitat enhancement projects in the Upper Salmon River basin.

**Degree of Program Measure Fulfillment:** The ALC flow augmentation project is only one of many projects that constitute Program Measure 704 (d)(1). Completion of the project, although significantly contributing to fulfillment of the Program Measure, will leave other portions of the Measure to be addressed.

**SALMON RIVER HABITAT ENHANCEMENT:  
BEAR VALLEY CREEK**

Richard C. Konopacky, Project Leader  
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BPA Project Number: 83-359  
Program Measure Number: 704 (d)(1)

**Relationship to Program Measure:** The objective of this project, which addresses Program Measure 704 (d) (1) Table 2, is to enhance 4.5 km of salmonid habitat within an inactive placer mine near the headwaters of Bear Valley Creek, Idaho. Fine granitic sediments (872 m<sup>3</sup>/year from 1979 to 1983) from the privately-owned mine have covered spawning gravels and filled in rearing areas of chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Salmo gairdneri*) since the mid-1950s. An ongoing feasibility study will determine the best alternative for enhancing salmonid

**habitat on the private land, which will subsequently influence habitat downstream.**

**Technical Results :** Pretreatment physical (one time/year) and biological (three times/year) variables were measured at seven sites within each of seven strata along the length (55 km) of Bear Valley Creek. Minimum and maximum water temperatures in all strata during August and September ranged from 0° to 4°C and 13° to 19°C, respectively. Riffle-pool area, flow, stream width and pool depth increased from upstream to downstream. The highest gradient (2.7%) was in the headwaters stratum. Strata above the mine and near the stream mouth had the most (84 to 87 cm/stream width) of riparian cover; the mine stratum had the least cover (30 cm/stream width). Highest frequencies of fine sediments on riffles occurred in strata immediately below the mine and immediately below the confluence with the largest tributary (Elk Creek) to Bear Valley Creek.

**In descending order of abundance, salmonid species in the stream included: chinook salmon, mountain white fish (*Prosopium williamsoni*), steelhead/rainbow trout, brook trout (*Salvelinus fontinalis*), cutthroat trout (*S. clarki*), and bull trout (*S. confluentus*). Densities of age 0+ chinook salmon were highest in the stratum below the mine; densities were higher during August than September throughout the stream. Length, weight, and condition of age 0+ chinook salmon increased from downstream to upstream. Age 0+ steelhead/rainbow densities were similar among, but variable within, strata. Densities of age 0+ mountain whitefish were highest in medial strata of Bear Valley Creek. Densities of adult whitefish were highest in downstream strata and below the mined area. Highest density of adult brook trout occurred in the stratum immediately below the mined area. Densities of adult cutthroat trout were highest in downstream strata. Highest densities of bull trout occurred in the headwaters stratum.**

**Technical Review:** Project documentation and reports from this project will be subjected to technical review by Idaho Department of Fish and Game, BPA, the U.S. Forest Service, and other agencies.

**Evaluation of Effectiveness :** We will evaluate treatment effects by monitoring aquatic habitat and fish communities over time. Baseline or pretreatment measurements were made in 1984.

**Degree of Program Measure Fulfillment:** The feasibility study is nearly complete. Fulfillment of the program measure depends on acceptance and implementation of the selected treatment, and on on-going monitoring efforts.

## **PANTHER CREEK, IDAHO, HABITAT REHABILITATION**

**Dudley W. Reiser, Project Leader**

**Bechtel Group, Inc.**

**P.O. Box 3965, San Francisco, California 94119, (415) 768-2135**

**BPA Project Officer: Larry Everson**

**BPA Project Number 84-29**

**Program Measure Number:: 704 (d) (1)**

**Relationship to Program Measure:** This project addresses Program Measure 700 aimed at increasing wild, natural, and artificial production of anadromous fish. Specifically, the project is involved with Section 704 (d)(1) of the program, which targets several streams within the Salmon River drainage for habitat enhancement projects. Panther Creek, cited as one of the target streams, has problems associated with mining, dredging, and sedimentation. The Panther Creek Project is focused on eliminating contaminants entering Panther Creek (primarily copper and iron emanating from an adjacent mine operation), thereby enhancing its water quality and habitat characteristics. The ultimate goal of the project is to allow the reestablishment of viable runs of chinook salmon and steelhead trout into the Panther Creek drainage, a system which contains about 100 miles of useable habitat.

**Technical Results:** The project has included geo-, hydro- and biological field studies. A geologic mapping program was conducted during the fall of 1984 in the mine area to locate contaminant sources. Simultaneous measurements of discharge and water quality were also taken to allow the computation of contaminant concentrations. Engineering studies are being used to help formulate specific abatement/reclamation measures for remedying the contaminant problem. Once appropriate measures have been identified, costs will be assigned and an implementation schedule developed.

Fisheries habitat surveys were also conducted during the fall. Quantitative assessments were made on 10 stations within the drainage, including five stations on Panther Creek, two on Moyer Creek and single stations on Musgrove, Deep, and Clear creeks; qualitative assessments were made on Napias and Beaver creeks. Data analysis is underway to estimate total habitat (steelhead and chinook) available in the drainage for fish production. Once the extent of the habitat is defined, quantitative estimates of smolt production will be made based on juvenile rearing and adult spawning spatial requirements. A cost estimate of the value of the habitat will be made and factored into an economic evaluation of the various abatement and reclamation measures.

**Technical Review:** The results of this project will be subject to an independent review by a formal Technical Advisory Committee. This committee is comprised of mine reclamation experts from AMAX Environmental Services, Inc., and fisheries experts from Idaho (Dr. Robert Raleigh and Dr. Jack Griffith). In addition, a draft report of the findings will be

**circulated to appropriate state and federal agencies and private companies for technical review and comment.**

**Evaluation of Effectiveness :** This phase of the project will result in the identification and conceptual design of remedial measures aimed at eliminating the toxic conditions in Panther Creek. The effectiveness of such measures can only be evaluated after they are implemented and appropriate monitoring programs have been initiated.

**Degree of Program Measure Fulfillment:** After this study is completed, several steps will be required to bring the Panther Creek drainage back into production. These include the implementation/construction of the remedial measures, monitoring of the measures for effectiveness, and the phased reintroduction (stocking) of salmon and steelhead into the drainage. Additional work will include evaluating the effectiveness of potential fish passage structures at several natural barriers in the drainage (Napias Creek, Deep Creek).

#### **IDAHO HABITAT EVALUATION FOR OFFSITE MITIGATION RECORD**

**Terry Holubetz , Project Leader  
Idaho Department of Fish and Game  
Box 25 Boise, Idaho 83707, (208) 466 2416  
BPA Project Officer: Larry Everson  
BPA Project Number: 83-7  
Program Measure Number : 794 (d)(1)**

**Relationship to Program Measure :** The objective of this project is to evaluate salmon and steelhead habitat improvement projects that have been or will be implemented in Idaho under Section 704 (d) (1) of the Fish and Wildlife program.

**Technical Results :** Most of the project activity in this first year was devoted to documenting physical and biological conditions in pretreatment and control sample sections; therefore, we could not assess the effectiveness of implementing habitat improvement measures.

**No pretreatment information could be collected on the Pole Creek, Crooked Fork, and Lo10 Creek projects because habitat improvement measures had been implemented prior to initiation of the Idaho Habitat Evaluation project. Post-treatment and control data were collected, but extremely low seeding levels prevented us from defining the project benefits this year.**

**Technical Review :** Meetings were held in the first quarter of 1984 to review the methodology used and the results obtained in the- first year of this project.

**Input and suggestions for alternative methodology were solicited from various entities, such as the U. S . Fish and Wildlife Service, National Marine Fisheries Service, Oregon Department of Fish and Wildlife, Washington Department of Fisheries, Columbia River Intertribal Fish Commission, U. S. Forest Service, and the Idaho Department of Fish and Game. Efforts are under way to establish a common methodology that could be used by all agencies throughout the Columbia River Basin.**

**Evaluation of Effectiveness :** This project is establishing the baseline data that will allow future evaluation work to define the benefits of individual habitat improvement projects. The project also provides a basis to assess the general effectiveness of the Fish and Wildlife Program. In future years, the data collected through this project will assist fish and wildlife agencies and tribes in steering future habitat improvement efforts toward the measures that provide the greatest benefits to the anadromous fisheries resources.

**Degree of Program Measure Fulfillment:** This project will be ongoing and will not fulfill its purpose until the habitat improvement measures under Section 704 (d) (1) are implemented in Idaho,

**FISH/WASH CREEK HABITAT IMPROVEMENT EVALUATION:  
CLACKAMAS RIVER, OREGON**

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BPA, Project Officer: Larry Everson  
BPA Project Number: 84-11  
Program Measure Number: 704 (d)(1)**

**Relationship to Program Measure:** This 5-year project, which began in 1983, is designed to evaluate habitat improvements constructed in the Fish Creek basin by personnel of the Estacada Ranger District, Mt. Hood National Forest. The project addresses Program Measure 704 (d) (1) and is jointly funded by BPA and the U. S'. Forest Service.

**The evaluation has focused on activities designed to improve spawning and rearing habitat for chinook and coho salmon and steelhead trout. Specific habitat improvements being evaluated include boulder berms, an off-channel pond, a side-channel, addition of large woody debris to stream edge habitats, and. hardwood plantings to improve riparian vegetation,**

**Factors in the basin that limit production of salmonids in Fish Creek, as well as physical and biological changes resulting from habitat improvement, are being evaluated.**

**Technical Results:** Results of this work to date indicate that spawning habitat is not limiting production of steelhead or coho in the basin. Coho habitat is presently underseeded because of inadequate escapement. Key summer habitats for coho, age 0, and age 1+ steelhead are beaver ponds, side channels, and pools, respectively. Key winter habitats appear to be groundwater-fed side channels and boulder-rubble stream margins with 30+ cm depth and low velocity water. Additional work is needed to determine whether summer habitat or winter habitat is limiting steelhead and coho production. Chinook use of the basin appears to be related to the timing of fall freshets that control migratory access into the system.

Instrem habitat improvements show varying degrees of promise, but all require some design modification before they can be used. Boulder berms designed to increase spawning habitat have already impounded small amounts of gravel and are providing spawning areas for steelhead. Some winter habitat was lost, however, as a result of construction at each berm site. An off-channel coho rearing pond produced a few exceptionally large coho smolts the first year after construction. A side channel development was used by spawning coho and chinook soon after construction in 1984, but few juvenile salmonids were found there in the winter of 1984-85. It is too soon to evaluate riparian plantings or addition of woody debris to stream edges.

**Technical Review:** Results of this work are reviewed in annual project presentations. Written reports will be subjected to technical review by agencies or groups selected by BPA.

**Evaluation of Effectiveness :** Comprehensive benefits or losses are difficult to determine for projects only one or two years old since fish response to improvements often takes several years. The success of each improvement must be measured in terms of increased smolt outputs.

**Degree of Program Measure Fulfillment:** Evaluation of habitat improvements in the Fish Creek Basin will be completed in 1988. Two ways to limit the risk of failure associated with habitat improvement projects are 1) to analyze in detail the limiting factors in a basin, and 2) to evaluate physical and biological changes in a basin (e. g. , smolts produced) that result from improvements.

**APPENDIX A**

**LIST OF WORKSHOP REGISTRANTS**

## APPENDIX A

### LIST OF WORKSHOP REGISTRANTS

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**APPENDIX B**

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## APPENDIX B

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